# Journal of FORESTRY

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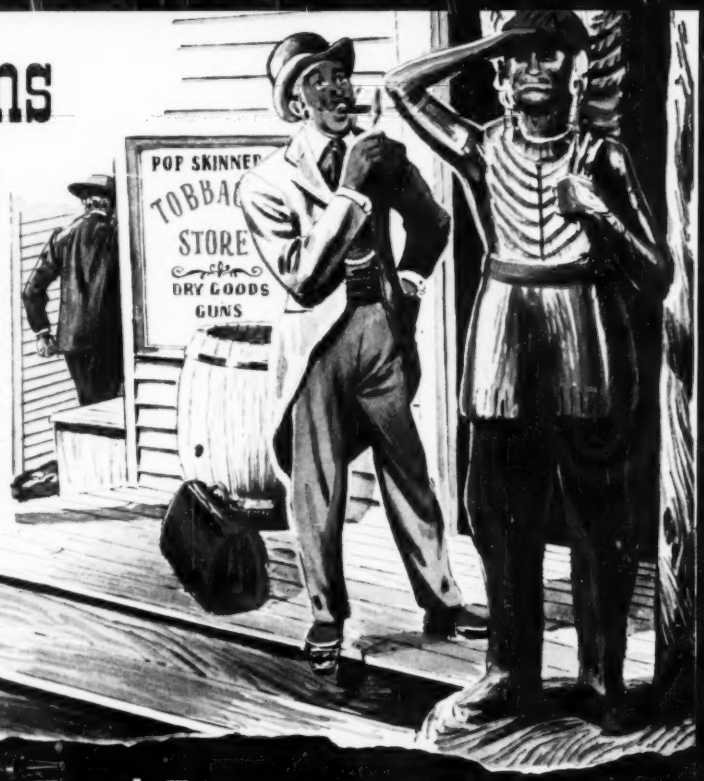


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# Journal of Forestry


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# Journal of Forestry

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## An Analysis of Investments in Pruning[1]

**Elmer W. Shaw and George R. Staebler**

Foresters, Puget Sound Research Center, Pacific Northwest Forest and Range Experiment Station.

*Is artificial forest pruning a good financial investment? This question confronts owners of young timber throughout the country. But "yes" or "no" answers are not always forthcoming—at least not without considerable qualifications. Yet the financial outcome of pruning can be estimated. This article suggests one way to make this important prediction.*

THE NEED FOR FOREST PRUNING is not generally understood, or at least not properly emphasized. In the conflict between present values and future values, it is usually the present values that win. Consequently, as long as high-grade virgin stands are able to supply the demand for clear lumber and prime face veneer, there is little concern about producing the supply that must some day come from young growth. For example, in the Douglas-fir region of Oregon and Washington it is estimated that 45,000 acres should be pruned *every year*, starting now, just to provide the volume of high grade logs that will be needed to sustain quality plywood production at present levels. Currently, less than one percent of this required acreage is being pruned annually. In the ponderosa pine of the Pacific Northwest, pruning has been more extensive; yet not more than 111,000 acres have been pruned during the past 20 years.

One of the reasons for this failure to prepare for expected needs is the lack of information on the long-term financial aspects of pruning. Neither private companies nor public foresters wish to invest money in extensive pruning unless they are convinced that it *pays*. The breaking point between profit and loss is often narrow and not well defined. The major problem, then, is to find out in terms of dollars and cents which are the best trees for the long-term pruning investment.

Several attempts have been made to provide such answers in a form that can be applied under a wide range of conditions. Obviously, a problem as variable and complex as pruning cannot be reduced to a simple formula. Neither research nor statistics completely replace seasoned judgment and broad experience; but alone, judgment and experience are not sufficient. Guides, tables, and research are needed to supplement experienced judgment whenever possible.

### Economic Factors

The ultimate profit or loss from pruning is determined by three factors: (1) the amount of usable clear wood produced as a result of pruning; (2) the difference in value between clear wood and knotty wood at the time of harvest; (3) the total cost accumulated at a chosen rate of interest for the required number of years.

These factors may be combined to give the following profit equation: Profit = volume of usable clear wood produced x difference in value — pruning costs accumulated at a chosen interest rate.[2]

Factors 1 and 3 of this equation —the growth of clear wood and the cost of pruning—can be evaluated mathematically to obtain good estimates of the investment required to produce clear wood by pruning. Whether the difference in value (the second factor) will be great enough to show a profit is not so susceptible to formula treatment. In this article no attempt is made to predict these values and, from them, ultimate profits. Rather, the aim is to show the added investment required to produce clear wood, with interest as a cost item, and to let the timber owner decide whether the cost is likely to be returned.

*Clear wood produced.*—Obviously, it is the first factor, the clear wood grown as a result of pruning, that must pay for the pruning. Whatever affects the volume of clear wood produced must be studied to determine not only its financial role but also its impact on management practices. Since clear wood is grown as a shell around a knotty core, its volume may be taken as the volume of the harvested log, less the volume of the knotty core, and, perhaps, less some allowances for incomplete utilization.

The diameter of the knotty core at the time of pruning equals d.b.h. times form class. However, it will be a few years after pruning until usable clear wood is produced. If the branch is sawed flush with the bark the cambium must grow outward the thickness of the bark before the stub can even begin to heal, so bark thickness must be included in the knotty core. (This emphasizes the necessity of making even cuts, as close to the bark as possible.) Then an allowance must

[1] This article is based upon the booklet, Financial aspects of pruning. Pacific Northwest Forest and Range Experiment Station, Portland, Oreg., August 1950.

[2] Interest at the chosen rate compounded annually—the familiar $1.0p^n$ where p = interest rate and n = number of years.

TABLE 1.—TOTAL PRUNING COST PER THOUSAND BOARD FEET OF CLEAR WOOD PRODUCED—SCRIBNER RULE. D.B.H. OF TREE WHEN PRUNED, 10 INCHES; INTEREST RATE 2½ PERCENT

| Average dia. growth per decade | Approx. No. rings per inch | Years after pruning | Attained d.b.h. | Growth clear wood | Total pruning cost per M board feet, when initial cost per tree, in cents, is | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 20 | 40 | 60 | 80 | 100 |
| *Inches* | | | *Inches* | *Board feet* | | | *Dollars* | | |
| 1.0 | 23 | 125 | 22.5 | 161 | 27.21 | 54.42 | 81.62 | 108.83 | 136.04 |
| 1.5 | 15 | 90 | 23.5 | 183 | 10.09 | 20.17 | 30.26 | 40.34 | 50.43 |
| | | 100 | 25.0 | 217 | 10.88 | 21.77 | 32.65 | 43.54 | 54.42 |
| 2.0 | 11 | 70 | 24.0 | 194 | 5.81 | 11.61 | 17.42 | 23.22 | 29.03 |
| | | 80 | 26.0 | 241 | 5.98 | 11.97 | 17.95 | 23.94 | 29.92 |
| | | 90 | 28.0 | 293 | 6.30 | 12.60 | 18.90 | 25.20 | 31.50 |
| | | 100 | 30.0 | 348 | 6.79 | 13.58 | 20.36 | 27.15 | 33.94 |
| 2.5 | 9 | 50 | 22.5 | 161 | 4.27 | 8.54 | 12.81 | 17.08 | 21.35 |
| | | 60 | 25.0 | 217 | 4.06 | 8.11 | 12.17 | 16.22 | 20.28 |
| | | 70 | 27.5 | 279 | 4.04 | 8.08 | 12.11 | 16.15 | 20.19 |
| | | 80 | 30.0 | 348 | 4.14 | 8.29 | 12.43 | 16.58 | 20.72 |
| | | 90 | 32.5 | 423 | 4.36 | 8.73 | 13.09 | 17.46 | 21.82 |
| | | 100 | 35.0 | 504 | 4.69 | 9.37 | 14.06 | 18.74 | 23.43 |
| 3.0 | 7 | 40 | 22.0 | 151 | 3.56 | 7.11 | 10.67 | 14.22 | 17.78 |
| | | 50 | 25.0 | 217 | 3.17 | 6.34 | 9.50 | 12.67 | 15.84 |
| | | 60 | 28.0 | 293 | 3.00 | 6.01 | 9.01 | 12.02 | 15.02 |
| | | 70 | 31.0 | 377 | 2.99 | 5.98 | 8.96 | 11.95 | 14.94 |
| | | 80 | 34.0 | 471 | 3.06 | 6.12 | 9.19 | 12.25 | 15.31 |
| | | 90 | 37.0 | 574 | 3.22 | 6.43 | 9.65 | 12.86 | 16.08 |
| | | 100 | 40.0 | 686 | 3.44 | 6.89 | 10.33 | 13.78 | 17.22 |

Growth of clear wood is growth on the first 16-foot log. Top d.i.b. of log equals .80 d.b.h. Diameter of knotty core assumed to be 2.0 inches larger than diameter of log at time of pruning. Minimum attained d.b.h. considered is 22.5 inches, which will yield a log whose diameter is 8 inches greater than diameter of knotty core.

be made for healing and for the impossibility of complete utilization of the clear wood. One amount may cover both healing and utilization allowances. The scaling diameter of the log at the time of harvest is determined by the d.b.h. and form class of the tree.

Of course these measurements vary somewhat with species. However, well-chosen values will apply to the great majority of the species and forest types of the United States. In the tables given in the original publication (*8*), of which Table 1 of this article is a sample, clear wood growing in the butt 16-foot log was computed using a form class of .80. Bark thickness allowance varied from .5 inch to 2.5 inches, depending on the d.b.h. of the tree, and 1 inch was allowed for healing and incomplete utilization. Studies in Douglas-fir (*1*) and loblolly pine (*5*) indicate that these are adequate allowances, at least for those species.

After these fixed, somewhat arbitrary allowances have been made, the volume of usable clear wood produced depends on both the diameter of the tree when pruned and the average rate of diameter growth for a given number of years. Of these two influences, growth rate is the more important. For example, a 6-inch tree that averages 1.5 inches growth per decade for 90 years grows only 142 board feet; by doubling the diameter growth rate, more than three times as much clear wood (476 board feet) is produced. Similar figures for a 10-inch tree are 183 and 574 board feet growth on the pruned section. However, it is often easier and cheaper to prune the smaller tree. These inter-related effects of size and growth rate show the need to integrate pruning, silvicultural practice, and management plans.

Pruned stands, especially fully stocked ones, should be carefully managed to maintain a high rate of growth. This may call for periodic thinning, intermediate harvest cuts, or selective cutting, depending on species and stand conditions. In stands where no release is planned, extra care should be taken to select for pruning trees that will not become retarded by competition. This usually means the larger trees in even-aged stands. In open-grown or medium stocked stands, crop-tree selection is relatively simple, but in young, even-aged, fully stocked stands it is more difficult to select the trees that will retain or gain dominance as they mature.

The fact that closely grown trees will eventually prune themselves naturally has often been presented as an argument against artificial pruning. At least it is claimed that not all the increased value should be attributed to pruning since some clear wood might have been produced anyhow. This may be partially true in some cases, but in general the time required to start growing clear wood without pruning is often as long as the planned rotation age itself. For example, research conducted by the Pacific Northwest Forest and Range Experiment Station and the Forest Products Laboratory has shown that in average stands of Douglas-fir 100 years or more are lost before a tree starts laying on commercial clear wood in the first 16-foot log (*3, 4, 7*). On the other hand, fast-growing trees with no competition or side shading may never yield any thing but rough, common grade lumber unless pruned artificially.

As an indication of the lumber grade recovery that may be expected from unpruned young-growth Douglas-fir, mill studies conducted by the Pacific Northwest Forest and Range Experiment Station in both Oregon and Washing-

ton may be cited (*6, 9*). The studies included 1,976 logs cut from trees 50 to 90 years old. Average lumber recovery was as follows:

32 percent select structural and select merchantable
53 percent No. 1 Common
13 percent No. 2 Common
2 percent No. 3 Common

These figures indicate that the young-growth stands are capable of producing good lumber in the structural and common grades, but they produce no lumber in the clear grades that are so important to the Douglas-fir trade. At present, virtually all the clear grades of Douglas-fir lumber are obtained from timber over 100 years old.

*Difference in value.*—The second factor that determines the profit in pruning is the difference in value between clear wood and knotty wood at the time of harvest. This difference cannot be accurately predicted when the tree is pruned but all trends suggest that the premium for clear wood will remain high, even in an age of cellulose. Consequently, current prices can be used as a conservative guide. In Douglas-fir, for example, a premium of $30 to $35 per thousand board feet above the price of sawmill grade logs is now being paid for peeler grades.

In the finished product the price difference is even greater. For example, in the retail lumber markets, clears sell for from two to five times more than knotty, common grades. In a recent study of the profit in pruning western white and ponderosa pine, comparisons between the mill recovery from unpruned logs and the theoretical recovery from pruned 16-foot butt logs with a 4-inch knotty core and a scaling diameter of 20 inches showed an additional value of $51.96 per thousand for western white pine and $60.70 per thousand for ponderosa pine, based on September 1949 lumber prices (*2*). For the concern that manufactures lumber or other products from its own pruned trees, this should actually be the criterion of value difference.

*Pruning costs.*—When pruning is considered a financial investment, the total cost (third factor of the equation) will include three items: (a) initial costs; (b) allowance for mortality; (c) interest.

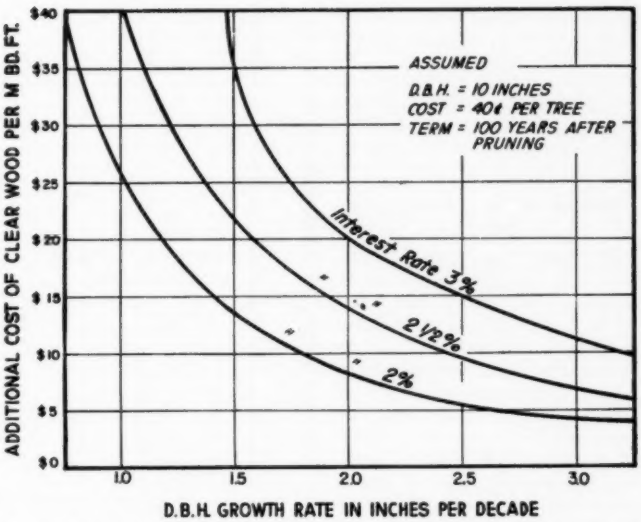


FIG. 1.—Rate of d.b.h. growth and interest as related to cost of clear wood produced by pruning.

The initial cost of pruning to a height of 18 feet varies widely, ranging from 15 cents to $1 a tree. A representative average would probably be from 30 to 50 cents a tree, but conditions throughout the nation differ so greatly that an accurate estimate for a particular stand should not be attempted without a field trial or thorough study based on similar projects. The main item of initial cost is labor, but other items to include are: transportation, camp expenses, tools, equipment, saw filing, maintenance, taxes, insurance, supervision, administration, tree marking, mapping, planning, and record keeping.

Not all trees pruned will live to be harvested as planned. Some will die, others will inevitably be badly damaged, and some will fail to make good growth and become suppressed. All these losses must be distributed over the pruned trees that do survive and are cut. For example, 100 trees are pruned at a cost of 50 cents a tree, or $50. Twenty percent of the trees die or fail to make crop trees; the remaining trees must bear the total pruning cost. Initial costs must then be computed as $50/80 or 62½ cents per tree. Estimates of the probable mortality should be based on the best available records for the species and area on which pruning is to be done.

After the initial pruning cost has been adjusted for probable mortality, then interest—the third cost item—should be computed. This is done by accumulating the adjusted cost at the chosen rate of interest for the desired number of years. Selecting the interest rate is primarily a management decision. The long-range program of the owner usually determines the rate of interest at which he is willing to invest his money; however, interest should not be used as an ironclad rule in deciding whether to prune. Like many other forest investments, pruning should be considered from several financial angles. Occasionally an investment may be justified on the basis of other values that more than compensate for the low financial return, but for the purpose of comparison it is customary to include compound interest at low rates. Some foresters have suggested, however, that pruning be consid-

ered as a current cost of operation with no interest charged against it, and that gains expected to result from pruning be figured as the interest rate that will be earned. From the long-term standpoint, especially on public lands, this viewpoint has much in its favor.

### Combined Effects of Economic Factors

In actual practice the factors that affect the pruning investment should be considered in their natural inter-relations to each other rather than separately. This can be shown best by tables and graphs. Figure 1 represents the effects of diameter growth and interest rates on the cost per thousand board feet of producing clear wood by pruning. The sharp drop of the curves emphasizes the importance of good growth. The effect of different rates of interest is indicated by the vertical space between the curves.

Figure 2 further illustrates how the cost of clear wood is influenced by the length of the holding period —the number of years between pruning and final harvest. When compound interest is introduced, a period of falling cost is followed by a period of rising costs. The period of minimum costs, however, does not necessarily determine the rotation age, for there are many other factors to consider in deciding the most desirable time for the final cut.

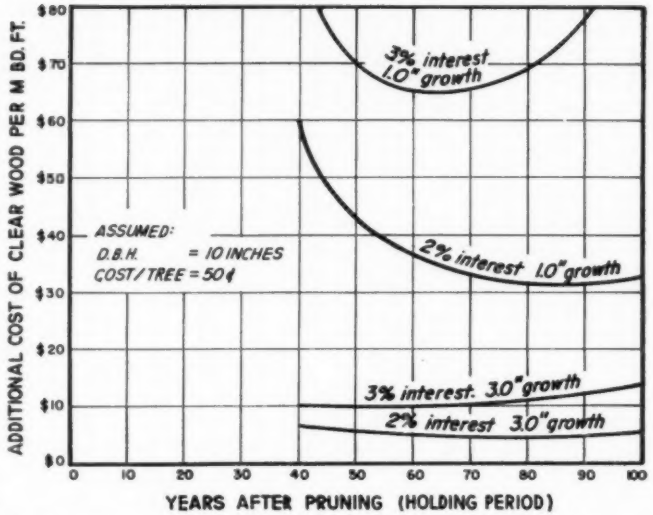


FIG. 2.—Effect of d.b.h. growth, per decade, and interest rates on the cost of producing clear wood by pruning.

*Problem*—(1) To determine the cost of producing clear wood by pruning at the Voight Creek Experimental Forest.
(2) To estimate the expected profit or loss on the investment.

Given —A 40 year old thinned stand of young-growth Douglas-fir on Site III.

| | |
|---|---|
| Average height of pruning | 18 feet |
| Average d.b.h. of trees pruned | 10 inches |
| Average rate of d.b.h. growth per decade | 2.0 inches |
| Initial pruning cost per tree | 25c |
| Allowance for mortality | 15% |
| Adjusted cost per tree (100% − 15% = 85%; 25c ÷ .85 = 29.4c | 30c |
| Interest rate | 2.5% |
| Holding period (between pruning and harvest) | 100 years |
| Number of trees pruned per acre | 100 |
| Expected harvest (trees per acre) | 85 |

*Assumed*—Premium of clear wood produced (difference in value between knotty wood and clear wood at time of harvest). $30/M

*Solution*—Consult Table 1, then interpolate for a pruning cost of 30c a tree using the data outlined above. The table reveals the following:

| | |
|---|---|
| Additional cost per M of clear wood produced | $10.18 |
| Attained d.b.h. | 30 inches |
| Yield of clear wood in the 16-ft. butt log. | 348 bd. ft. |

By using an assumed future value the profit may be estimated as follows:

| | | |
|---|---|---|
| Assumed premium per M for clear wood | | $30.00 |
| Pruning cost per M b.m. | $0.72 | |
| Allowance for mortality | .14 | |
| Total direct costs per M | .86 | |
| Interest charges | 9.32 | |
| Total cost per M b.m. to produce | | 10.18 |
| Profit per M b.m. on clear wood produced | | 19.82 |
| Profit per tree $19.82 × .348 M b.m. | | 6.90 |
| Profit per acre $6.90 × 85 | | 586.50 |

This means that under these conditions, pruning 100 trees at a cost of $25 will return $568.50 more than would be realized on an investment of $25 in securities paying 2.5 percent compound interest for 100 years. Stated another way, it means that the $25 invested in pruning an acre of trees will earn approximately 3.6 percent compound interest for 100 years or a total of $862.75.

### Application

To illustrate these economic factors more concretely, records from a pruning study conducted in young-growth Douglas-fir from 1949 to 1952 on the Voight Creek Experimental Forest near Orting, Wash., are included here. This forest is a 230-acre tract dedicated to intensive research, and managed cooperatively by the St. Paul and Tacoma Lumber Company and the Pacific Northwest Forest and Range Experiment Station. Data used in the solution of the following problems are taken from published tables (*8*).

The booklet upon which this article is based (*8*) contains 14 pages of tables, presenting data for different rates of interest, tree sizes, growth rates, holding periods, and initial pruning costs. By using such tables each variable can be analyzed independently to determine its influence on the pruning investment. Such an analysis is

valuable in selecting prospective stands for pruning. It is equally helpful in determining what size and type of tree within the stand itself should be pruned.

### Conclusion

Artificial forest pruning is essential in young stands if clear, high-grade wood is to be produced in a reasonable length of time. The approximate cost of producing clear wood by pruning can be calculated in advance by a careful analysis of the factors involved. Likewise, if a future difference in value between clear wood and knotty wood is assumed, the profit or loss on the pruning investment can also be predicted.

The most important factor in determining the final profit is generally the average rate of diameter growth on the pruned section. Trees with diameter growth rates less than 1.5 inches per decade, or 15 rings per inch not counting the bark growth, are unlikely to be profitable pruning chances. Of all the various pruning costs, compound interest usually has the greatest effect upon the ultimate margin of profit. Unless growth is exceptionally rapid, high rates of compound interest cannot be charged and still show a net gain on the investment. However, the use of interest and carrying charges as a cost of pruning is an accounting problem subject to different points of view. Consequently, the forest owner himself should decide whether to use compound interest, and if so, what rate to allow.

Study of these financial aspects will show that pruning, when properly done, is a sound investment. Therefore, artificial forest pruning in thrifty, young stands should be widely encouraged.

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# Calculation of Volume of Hardwood Logging Waste[1]

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EXISTING LOGGING TECHNIQUES leave a large part of the total volume of a tree in the woods. Ordinarily, logging waste[2] is in the form of tops, stumps, jump-butts, and breakage.

Determination of the total volume in hardwood trees is never a simple problem because of the difficulty in calculating volume in the tops. Girard and Gevorkiantz[3] found a linear correlation between volume in the top and the product of basal area and length of the top, called the dimension factor. Calculation of the dimension factor, however, requires reference to a table of basal areas. A method of estimating logging waste in hardwood trees was developed recently at Purdue University. This method requires an estimation of the percentage of the total height of the tree that is merchantable, called merchantability ratio, rather than the length of the top in feet. Estimates of merchantability ratio to the nearest 10 percent should not be difficult; a straight rule graduated in 10 units may be used for this purpose.

Using the merchantability ratio, diameter breast high, and merchantable height, the ratio of total volume (to a 4-inch top) to the merchantable volume can be computed from a multiple regression of the form:

$$VR = a + b(D) + c(H) + d(MR)$$

where VR = ratio of total volume to merchantable volume
D = diameter in inches
H = merchantable height in feet
MR = merchantability ratio
a = regression constant
b, c, & d = regression coefficients

Woods waste per tree can be calculated by multiplying merchantable volume per tree by one less than the ratio of total volume to merchantable volume (VR). Merchantable volume per tree can be computed from estimated log diameters and lengths or from local volume tables. For example, if a tree had a volume ratio (VR) of 1.70 and a merchantable volume of 40 cubic feet, the logging waste would be calculated as follows:

$$\text{Waste} = (1.70 - 1) \times 40$$
$$= 0.70 \times 40$$
$$= 28.0 \text{ cubic feet}$$

During 1949 and 1950, detailed measurements were made on 101 hardwood trees of 13 species cut from three areas in north-central Indiana. These measurements made possible the calculation of the cubic volume in the stump, logs, top, and any cull section cut from the tree. A least squares analysis of these volume data resulted in the following equation for predicting ratio of total volume to merchantable volume:

$$VR = 2.44 + 0.0484\,(D) - 0.0090\,(H) - 3.65\,(MR)$$

The three independent variables were found to rank in decreasing order of importance: merchantability ratio, diameter, and height. The standard partial regression coefficients were -0.552, 0.353, and -0.112 respectively.

About 90 percent of the logging waste in north-central Indiana was found to be in tops. Slightly less than 10 percent was in stumps and only 1 percent was due to jump-butts and breakage. As would be expected, logging waste was considerably higher in the few trees which had been jump-butted than in sound trees of similar dimensions. However, there was insufficient data in this study to permit a quantative analysis of this difference.

Table 1 shows ratios of total volume to merchantable volume as computed from the regression above. It is not expected that these data will be widely applicable. There is no reason, however, why this method of determining top volume could not be used in any area once the basic data have been accumulated.

TABLE 1.—RATIO OF TOTAL AMOUNT TO MERCHANTABLE VOLUME[1]

| Diameter breast high | Merchantability ratio | Merchantable height in 12-foot logs | | | |
|---|---|---|---|---|---|
| | | 1 Log | 2 Log | 3 Log | 4 Log |
| *Inches* | | | | | |
| 12 | 2/10 | 2.18 | | | |
| | 3/10 | 1.82 | 1.71 | | |
| | 4/10 | | 1.35 | | |
| 16 | 2/10 | 2.38 | | | |
| | 3/10 | 2.01 | 1.90 | | |
| | 4/10 | | 1.54 | 1.43 | |
| 20 | 2/10 | 2.57 | | | |
| | 3/10 | | 2.10 | | |
| | 4/10 | | 1.73 | 1.63 | |
| | 5/10 | | | 1.26 | |
| 24 | 2/10 | 2.76 | | | |
| | 3/10 | | 2.29 | | |
| | 4/10 | | 1.93 | 1.82 | |
| | 5/10 | | 1.56 | 1.45 | 1.35 |
| 28 | 2/10 | 2.96 | | | |
| | 3/10 | | 2.49 | | |
| | 4/10 | | 2.12 | 2.01 | |
| | 5/10 | | 1.76 | 1.65 | 1.54 |
| | 6/10 | | | 1.28 | |
| 32 | 2/10 | 3.15 | | | |
| | 3/10 | | 2.68 | | |
| | 4/10 | | 2.31 | 2.21 | |
| | 5/10 | | 1.95 | 1.84 | 1.73 |
| | 6/10 | | | 1.48 | 1.37 |

[1] $\dfrac{\text{Total volume}}{\text{Merchantable volume}} = 2.44 + 0.0484\,(\text{diameter}) - 0.0090\,(\text{height}) - 3.65\,(\text{merchantability ratio}).$

[1]Journal Paper No. 576 of the Purdue Agricultural Experiment Station.

[2]The term waste as used here means all fractions of a hardwood tree except bark and limbs less than 4 inches in diameter that are not used.

[3]Girard, J. and S. R. Gevorkiantz. Timber cruising. U. S. Forest Service Publication. 1939.

# Altitudinal Races of Pinus Ponderosa—A 12-Year Progress Report

**N. T. Mirov, J. W. Duffield, and A. R. Liddicoet**
Institute of Forest Genetics, California Forest and Range Experiment Station.[1]

PROVENIENCE STUDIES of forest tree species have contributed heavily to the literature of silviculture. Three comprehensive reviews are by Champion (*3*), Kalela (*6*), and Langlet (*8*). Some of the more recent studies have dealt specifically with a single geographic variable such as latitude (Langlet. *10*), longitude (Schmidt, *13*), or altitude. Recent studies in which altitude of seed tree location was taken as the independent variable are those of Burger (*2*) and Karschon (*7*), concerned with *Pinus sylvestris* and *Picea excelsa*; of Pavari and de Phillippis (*11*), who studied *Pinus contorta;* of Fisher (*4*), who studied *Picea excelsa;* and of Isaac (*5*) who reported on behavior of planted *Pseudotsuga taxifolia* in relation to altitude. Studies dealing with altitudinal races of *Pinus ponderosa* have been reported by Austin (*1*), Weidman (*15*), and Pavari and de Phillippis (*11*).

This article reports the first 12 years' results from a study of the relation between rate of growth and altitude of seed tree location. The study was started in 1938. Previous work (*1*) had indicated that rate of growth of planted *Pinus ponderosa* was inversely related in a linear manner, to altitude of seed tree location, within the area of El Dorado County, California and adjacent portions of several other counties in California and western Nevada. The present study was undertaken to define this relationship more precisely and to study the relative growth rates and cold hardiness of various altitudinal proveniences when grown at several altitudes. The altidudinal races were represented by 89 seed trees of ponderosa pine growing in the Sierra Nevada of California. These trees were part of a group of several hundred seed trees included in a more comprehensive test started in 1937 to evaluate the heritable vigor of seed trees on the basis of rate of growth of open-pollinated progenies.

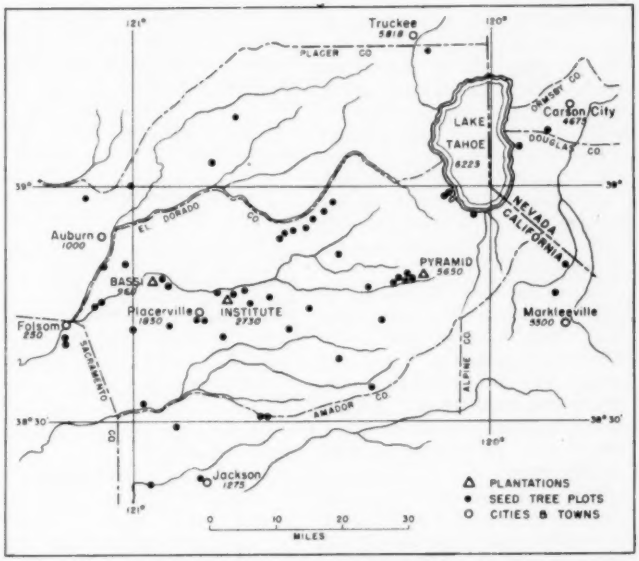


FIG. 1.—Map of El Dorado County, California and adjacent territory, showing distribution of seed tree plots, plantation sites, altitudes, and drainages.

Few investigators of forest tree provenience problems are fortunate enough to carry through their experiments from seed to sawlog. Generally, it falls to a second or third generation of workers to analyze and interpret data from experiments which they had no part in designing or establishing. Meanwhile, modes of experimental design have changed and new knowledge has accumulated with the result that the analyst finds the design less than ideally suited to the production of meaningful answers. On the positive side, the analyst stands to receive undue credit for reporting on a study in which he may have played a small part. All this is true of the present study.[2]

This report deals principally with findings of silvicultural interest. An account of the findings which bear on evolutionary biology will be given elsewhere. Likewise, a portion of the study dealing with *P. jeffreyi* will be reported separately.

[1]The Experiment Station is maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of California, Berkeley.

[2]The conception and design of the experiment was largely the work of Lloyd Austin, who directed the work from the seed collection phases in 1934 through the fifth year of growth of the plants. Advice on the conduct of transplant studies was given by J. Clausen and W. M. Heisey of the Division of Plant Biology, Carnegie Institution of Washington, Stanford, Calif. A. A. Hasel and K. G. Brecheen, both formerly of the California Forest and Range Experiment Station, gave statistical advice and assistance. W. C. Cumming was largely responsible for the seed tree location and seed collection phases of the study. C. R. Berriman and E. F. Kimbrough conducted nursery and plantation operations. Plantation measurements were made by A. R. Liddicoet, E. F. Kimbrough, and E. J. Carpender. Studies of soil and climate at the various nursery and plantation sites were conducted by N. T. Mirov, who assumed responsibility for the whole experiment in 1945 and who prepared two progress reports (unpublished) on the study, while A. R. Liddicoet and J. W. Duffield accomplished the statistical analyses incorporated in the present report.

## Materials, Sites, and Procedures

The seed used in this experiment was part of that left over from the comprehensive open-pollinated progeny test of 1937. Seed trees were growing along the western slope of the Sierra Nevada (Fig. 1) at elevations from 125 to 6,919 feet above sea level and at a latitude of 39° North. The seed trees were selected, usually in groups, without regard to growth rate or appearance, except that malformed trees were avoided. Only trees bearing at least ten cones were selected. Collections were made in the autumns of 1934 and 1936.

Before the cones were opened to extract seed, measurements of cone length and diameter were taken. Air-drying sufficed to open the cones. After the seed was extracted, the mean seed size for each tree was determined and expressed as number of cubic centimeters occupied by 200 seeds.

Plantation sites were chosen at three elevations (Fig. 1). The low elevation site is on the Bassi Ranch at an elevation of 960 feet above sea level, in the valley of the South Fork of the American River about two miles downstream from Lotus, El Dorado County. The medium elevation plantation is at the Institute of Forest Genetics, situated on the top of the ridge south of the South Fork of the American River, about four miles east of Placerville, at an elevation of 2,730 feet. The high elevation plantation is on a south-facing slope above the South Fork of the American River at 5,650 feet above sea level about a mile west of Strawberry Resort on U. S. Highway No. 50. This is known as the Pyramid Plantation.[3] Nurseries were established near each of these plantation sites in the spring of 1938.

Climate at the three sites has been studied in varying detail. Records at the Institute date back to 1930 and are fairly complete; those at the Bassi plantation run from 1938 to 1942; those at the Pyramid plantation run, with wartime interruptions, from 1938 to 1947 with a record of minimum temperatures up to 1950 (Table 1 and Fig. 2). The Bassi plantation has high maximum temperatures, and as a result of the cold air which flows down the American River Canyon, has lower night temperatures (Fig. 2) and fewer days without frost than the Institute plantation, which is situated on a ridge top. The Pyramid plantation shows a temperature amplitude (Fig. 2) similar to that at Bassi, and 179 days without frost (average for a three-year period) as compared with 335 at the Institute and 314 at the Bassi plantation.

When growing season is computed as number of days between last spring frost and first fall frost, for the period 1927-1937, the Insti-

TABLE 1.—TEMPERATURE AND PRECIPITATION DATA AT PLANTATION SITES

| Item | Bassi site 960 ft. | Institute site 2,730 ft. | Pyramid site 5,650 ft. |
|---|---|---|---|
| Absolute Maximum Temp. (°F) | 108 | 106 | 92 |
| Absolute Minimum Temp. (°F) | 21 | 12 | −6 |
| Mean Annual Temperature (°F) | 59 | 58 | 47 |
| Mean Temp. of Hottest Month (°F) | 78 | 76 | 63 |
| Mean Temp. of Coldest Month (°F) | 45 | 44 | 33 |
| Mean Annual Precip. (Inches) | ... | 39.52 | 42.24 |
| 1940 Precip. (Inches) | 45.49 | 58.79 | 63.73 |
| Minimum Precip. (Inches) | ... | 24.89 | 30.71 |
| Maximum Precip. (Inches) | ... | 59.02 | 63.73 |

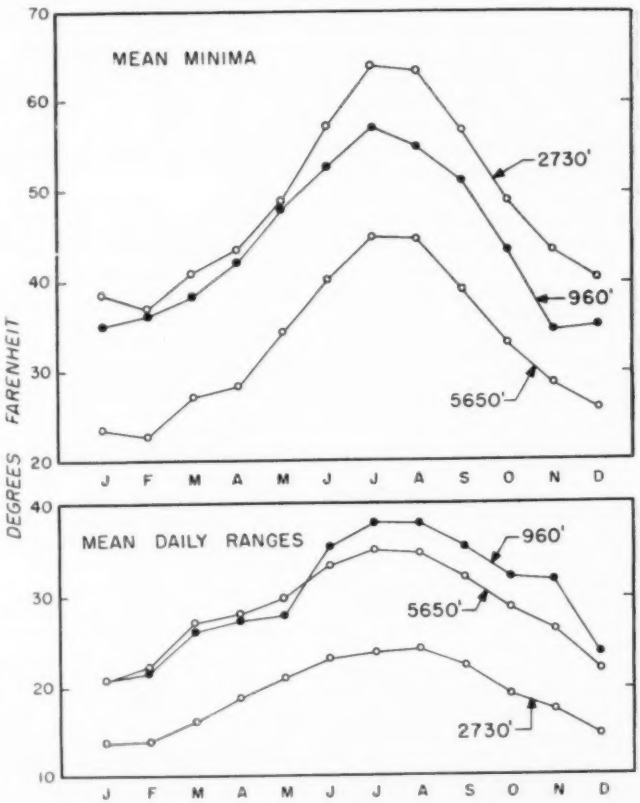


FIG. 2.—Monthly temperatures at the three plantation sites.

[3]This plantation and the adjacent nursery were established on land in the El dorado National Forest. It is a pleasure to acknowledge the cooperation and interest of numerous members of the national forest staff.

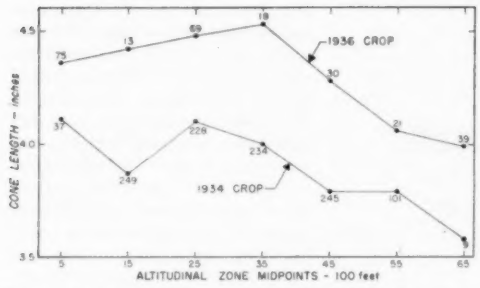


FIG. 3.—Cone length in relation to seed tree altitudes. (Numerals at points indicate number of seed trees.)

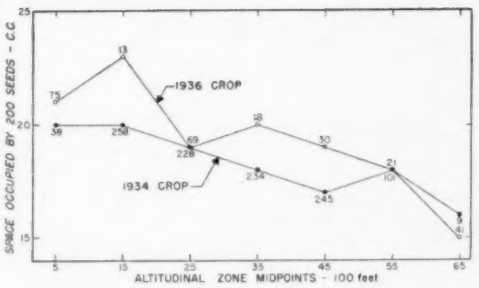


FIG. 4.—Seed size in relation to seed tree altitudes.

tute growing season averages 240 days and that at Placerville in the canyon of Hangtown Creek at an elevation of 1,925 feet averages 167 days.

Thus the thermal regime at the Institute is milder and more uniform than at the higher or lower stations. Whether the sampling of climates at these three stations is adequate to permit generalization concerning temperature regimes in relation to altitude on the west slope of the Sierra Nevada is open to question.

The climate at the Institute may be milder than the average for the 2,700 foot elevation zone and that at Bassi may be more severe than the average for the 1,000 foot zone.

Precipitation at the two lower plantations is mostly in the form of rain, although there are occasional snowfalls of as much as 24 inches at the Institute. Few snowfall data have been systematically recorded for the Pyramid plantation. Depths up to 6 feet have been noted, and it has also been observed that some of the lowest temperatures may occur when there is no snow cover.

Pearson (*12*) in his comparison of climates in ponderosa pine regions, did not include "temperature and precipitation graphs for the ponderosa pine-sugar pine type of California," which describes the area of this study, "because this is not regarded as a true ponderosa pine type." The California graphs included in Pearson's paper are based on seven stations in the northeastern part of the state, all of which have a more severe climate than is found on the west slope of the Sierra Nevada. These "east-side" stations, however, resemble the west slope in having a pronounced summer drought in contrast to the summer rainfall characteristic of the Black Hills and Arizona ponderosa pine regions.

Nursery procedure was essentially that outlined by Liddicoet and Kimbrough (*10*). Seeds from certain trees were graded by size in order to furnish supplementary data on the effect of seed size on seedling size. Sowings were made according to the following schedule:

| Nursery altitude | Sowing date |
|---|---|
| 960 feet | May 1 |
| 2,730 feet | May 1 |
| 2,730 feet | May 25 |
| 5,650 feet | May 26 |

The two sowings in the nursery at 2,730 feet were made to coincide with those in the nurseries at 960 and 5,650 feet, respectively. In the spring of 1940, 2-0 stock was lifted and planted in the adjacent plantation sites. Stock from the May 1 sowing in the 2,730 foot nursery was used for the 2,370 foot plantation.

The plantations were made up of square plots, each consisting of 16 trees, spaced 8 by 8 feet, and separated by a 16-foot strip from adjacent plots. Most 16-tree plots contained trees derived from 8 to 12 different seed trees within the same 1,000-foot altitudinal zone. Some plots contained progeny of a single seed tree. Six different seed trees were so represented. The plots were laid out in four blocks in a restricted - random arrangement. Each block contained 16 plots of the following composition:

7 plots—one for each 1,000 foot elevation zone.
3 plots—each representing several seed trees growing near the three plantation sites.
6 plots—each containing the progeny of a single seed tree.

Altogether, 89 trees were represented in these plantations, and the representation in each plantation was identical. The block and plot arrangement in the three plantations differed in order to take advantage of the land available.

Height of seedlings was measured at 1 year and 2 years in the nurseries and height of planted trees was measured at 3, 5, 7, 8, and 12 years (age from seed). During 1947 and 1948, weekly measurements of shoot elongation were taken on 4 trees from each of the seven altitudinal origins in both the Institute and Pyramid plantations.

Pot culture tests were conducted with soil from each of the plantation sites, using ponderosa pine seedlings as test plants.

## Results

Two conclusions emerge from the cone-length data (Fig. 3) gathered in the course of seed extraction. First, the cones produced in 1936 were larger than those produced in 1934. This is clear in spite of the fact that the groups of seed sampled in the two years were not identical (a considerable number of the seed trees, however, contributed to both harvests). This illustrates one of the difficulties in experiments with forest trees; the replications in successive years which

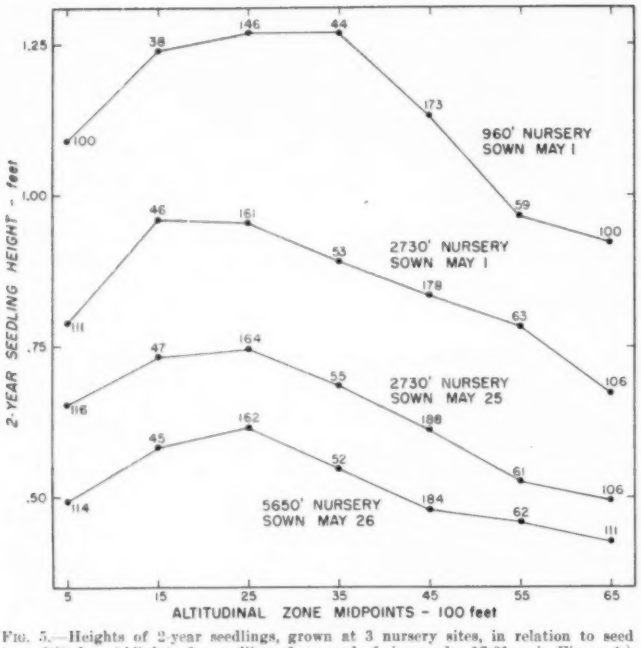


FIG. 5.—Heights of 2-year seedlings, grown at 3 nursery sites, in relation to seed tree altitudes. (All data for seedlings from seed of size grades 17-21 as in Figure 4.)

are commonplace in agronomic tests are equally important but more expensive in the plantation phases of forest tree studies. Secondly, there is a clear indication that the trees at higher elevations produced shorter cones than those at lower elevations. This is true for both years.

Seed size (Fig. 4) shows the same trends as were noted in cone size. Cone size and seed size are known to be closely correlated (Wright, *16*).

Two-year heights of seedlings (Fig. 5) show the same phenomenon for all 4 sowings. The curves rise from the lowest elevational zone (mid-point 500 feet) to maxima at elevations varying from 1,500 to 3,500 feet with a steep decline to the highest elevations. Since only the data for seedlings from seeds of the median size classes (17-21) were plotted, these curves are little affected by the relation between altitude of seed tree and seed size shown in Figure 4. When data for seedlings from seeds of all size classes were plotted, the regression line of seedling height on seed-tree altitude was steeper—its slope was clearly the resultant of two altitude effects acting in the same direction, i.e. the negative regressions of cone size and seedling growth-rate on altitude.

Detailed analysis of height-growth data is confined to the 8-year measurements at the Bassi and Institute plantations and the 12-year measurements at the Institute and Pyramid plantations. Preliminary analysis consisted of determining the mean height of trees from each of the seven 1,000-foot altitudinal zones. These means showed a trend similar to means of 2-year heights—a maximum in the 1,500 to 3,500 foot zones, with the means of the 500 foot zone higher than that of the 5,500 and 6,500 foot zones. Following the suggestion of A. A. Hasel, a second type of analysis was made. Grouping of seed trees by zones was disregarded, and second-degree curves were fitted to show the relation between 8- or 12-year height and altitude of each seed tree. Multiple regression equations were computed by the method of Snedecor (*14*), the variables being as follows:

$X_1$ = altitude of seed tree.
$X_2$ = altitude squared.
Y = 8- or 12-year height of progeny.

Table 2 briefly summarizes the results of the four curvilinear regression analyses.

In all cases, the curves (Fig. 6 and 7) fit the data significantly better than a straight line, and in all cases the coefficient of multiple correlation is significant. The small superiority of the 8-year heights at the Institute plantation over those at the Bassi plantation reverses the difference exhibited in the nurseries at 2 years of age (compare Fig. 5 and 6). This is most probably a consequence of the cessation of watering on all sites after the fourth year. Since that time, the more favorable precipitation and temperature regimes at the Institute probably have more than compensated for the more fertile soil of the Bassi site.

In order to investigate more closely the relation between altitude of seed tree and height growth of progeny for seed trees growing below 3,000 feet, linear regression and correlation coefficients were computed. Such analysis showed a non-significant correlation for the Institute plantation data, as may be surmised from inspection of Figures 6 and 7. However, for the Bassi and Pyramid plantation data,

TABLE 2.—CORRELATION COEFFICIENTS AND F VALUES FOR RELATION BETWEEN HEIGHT-GROWTH AND SEED-TREE ALTITUDE

| Item | For 8-year heights at | | For 12-year heights at | |
|---|---|---|---|---|
| | 960-foot plantation | 2,730-foot plantation | 2,730-foot plantation | 5,650-foot plantation |
| R[1] | 0.704[4] | 0.680[3] | 0.677[3] | 0.288[4] |
| F[2] | 6.253[4] | 9.772[4] | 17.00[3] | 5.095[4] |

[1]Coefficient of multiple correlation.
[2]F resulting from variance analysis designed to test superiority of the fit achieved by curved line (Snedecor, *14*, pages 379-382).
[3]Highly significant. Probability 1% or less.
[4]Significant. Probability 5% or less.

highly significant (r=0.541 and r=0.580 respectively) positive correlations were found. Thus it appears that in the Institute plantation, altitude of seed tree has no demonstrable effect below 3,000 feet but above this level is an important factor. In the higher and lower plantations, the superiority of progenies from seed trees of the 1,500 to 3,500 foot zone is clearly indicated.

Additional evidence for the superiority of the seed trees of the 1,500 to 3,500 foot zone is found in the volume data for 2-year old seedlings which formed the basis for the comprehensive progeny test referred to earlier. These seedlings were derived from a group of 646 seed trees including the 89 seed trees which form the basis of the present study. Seedling volume for the more inclusive sample of seed trees shows the same relation to altitude exhibited in Figure 5.

The data on shoot elongation do not yield as clear results—perhaps because of the relatively small number of trees sampled. In handling data of this sort, one is confronted with the problem of determining when growth starts and stops. Often growth is arbitrarily assumed to have started when 5 percent of the seasonal growth has occurred and to have ceased when 95 percent of the seasonal growth has occurred. It was thought that in the present study, where duration of growth of groups of trees known to differ in total seasonal growth was to be compared, this method might confound the results. Accordingly, the following procedure was followed:

a. Calculate weekly increments by subtraction.

b. Divide total season's elongation by length of season in weeks.

c. When weekly increment as calculated in *a* rose to the mean calculated in *b*, the grand period of growth was considered to have started. When the weekly increment fell to the seasonal mean again, the grand period was considered terminated.

When determined by this method, the grand period of growth was found to account for between 85 and 95 percent of total seasonal elongation.

Since elongation is much smaller at the Pyramid plantation, the small sample (28 trees) taken here gave no clear-cut results. Sampling error was too large. The data from the Institute plantation were somewhat more satisfactory. Here in 1948, duration of grand period and daily elongation during the grand period were negatively correlated with altitude of seed tree

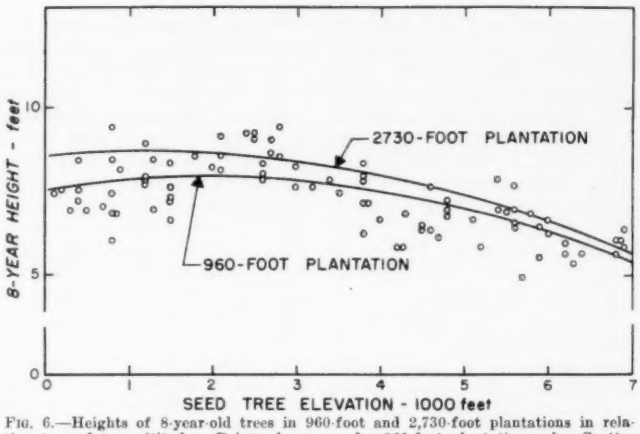


FIG. 6.—Heights of 8-year-old trees in 960-foot and 2,730-foot plantations in relation to seed tree altitudes. Points shown are for 960-foot plantation only. Scatter of points for the 2,730-foot plantation is omitted to avoid confusion. Each point represents the progeny of a single seed tree.

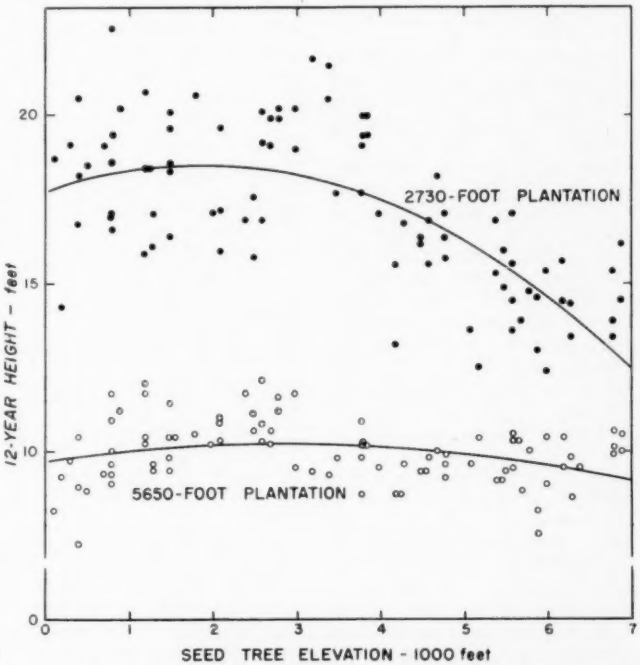


FIG. 7.—Heights of 12-year-old trees in 2,730-foot and 5,650-foot plantations in relation to seed tree altitudes.

($r = -0.400$ and $r = -0.449$, respectively; P less than 5 percent in both cases). In 1947, daily elongation during the grand period was negatively, but not significantly, correlated with altitude of seed tree. Thus it seems that the superior height growth of the lower altitude trees may be attributed to both longer-sustained and more rapid elongation.

## Discussion

The data presented raise several points of silvicultural interest. The most obvious is the inadvisability of using seed of high altitude origin for reforestation at lower elevations. A definite loss of production is likely to follow from such a practice. Can one, on the other hand, safely use seed of low altitude origin for reforestation at higher elevations? The answer to this question cannot be final, and so far as an answer can be framed at present, it must be carefully qualified. There has been some winter injury at the Pyramid plantation (5,650 feet). This occurred principally during the winter of 1948-49 when a minimum of −5.8 degrees F. was recorded, and the plantation was subjected to cold dry winds from the southeast for a period of several days during which no snow was present to protect the trees. All trees were scored for winter injury, and analysis of the data revealed no relationship between seed origin and foliage injury. No trees were killed. Thus there is yet no evidence that it is unsafe to move ponderosa pine up the west slopes of the Sierra Nevada. This finding should not be stretched too far, however, for the trees are still young, and the 13 winters which they have so far withstood probably do not adequately sample the winter climate at this elevation. Furthermore, it should be realized that even up to 7,000 feet the west slope of the Sierra Nevada has a winter climate which, with absolute minima little lower than −15 degrees (recorded at Pinecrest in the cold winter of 1948-49), is milder than that in many other parts of the range of ponderosa pine.

A second point is the finding that the fastest-growing plants come from lower-middle elevation seed trees rather than from the lowest elevations. This fact emerges with great clarity from the data, and is a phenomenon which has not been uncovered in other studies of elevational races of forest trees. Perhaps *Pinus ponderosa*, covering such a wide elevational span on a single gradual slope, is uniquely suited to develop such a series of populations. In any event, the practical conclusion which seems to be indicated is that the optimum seed collection zone lies between 1,500 and 3,500 feet on the west slope of the Sierra Nevada.

Admittedly, the sampling of seed trees may not be adequate to establish beyond question the conclusion that seed trees from this zone yield faster-growing progenies than seed trees from the lowest elevations. Today, on the west slope of the Sierra Nevada, ponderosa pine occurs mainly as scattered individuals and groups at the lower elevations. Certain of the isolated seed trees have produced progenies which appear to include a high proportion of inbreds, slow-growing and of poor form. This fact may partly account for the poor performance of the seedling progenies from low elevation seed trees. Nevertheless, a comparison of 8-year height of progenies from four isolated seed trees with the height of progenies from nine seed trees in stands all in the 0 to 1,000 elevation zone showed no significant difference in any of the test plantations.

Thirdly, the present study, like other studies of provenience, raises questions about the problem of evaluating timber site quality. This problem is by no means simple, and the current practice of using height of dominants at a given age is probably the best available. Nevertheless, it would be well to realize that an ideal method of site quality determination would take into account the genetic variation within species which provenience studies reveal. Perhaps, generally lower quality of high elevation sites is partly a consequence of the inherently slow growth rate of the trees which grow on them. In fact, pot culture tests of soil from the Pyramid plantation showed this soil to be capable of supporting faster growth of pine seedlings derived from a seed tree at the Institute than soil from either the Institute or the Bassi plantations.

One may ask why, if these lower-middle elevation seed trees produce faster-growing progeny apparently hardy at higher elevations, these progenies do not invade the higher elevations? What, in other words, has prevented the development of a genetically homogeneous population in the essentially continuous ponderosa pine forest of the west slope of the Sierra Nevada? The present study sheds no light on this problem. Perhaps the answer might be found in some subtle differences in ability to establish seedlings. Working over long periods and maintained by the differences in pollination time associated with differences in altitude, small heritable differences in seed and seedling physiology would suffice to maintain the gradients we now find.

## Summary

The first 12 years' growth of trees of *Pinus ponderosa* derived from seed trees distributed from 125 to 6,919 feet above sea level on the west slope of the northern Sierra Nevada in California was studied in plantations at 960, 2,730, and 5,650 feet above sea level. Height growth of plants from 2 to 12 years showed a maximum for seed trees situated from 1,500 to 3,500 feet above sea level. The same result was found in all three plantations. No differential winter injury was sustained up to 13 years at the higher elevation plantation.

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# Cost Accounting in TVA Forest Nurseries

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WITH THE RISING COST of materials, equipment, and labor taking bigger and bigger portions of budgeted funds, nurserymen are all asking the same question: How can we meet the increasing demand for seedlings without sacrificing quality? Mechanization and modernization have helped so far. As an additional safeguard the use of an accounting system that enables the nurseryman to analyze his expenditures accurately and establish controls accordingly is suggested.

Records of total costs and total production will give an average unit cost for all species. This might be helpful if all species costs were the same and if all the factors affecting production of forest tree seedlings remained the same from year to year. But techniques and methods—and thus costs—vary by species. No two years are the same. Production varies both in number and species; techniques change; equipment is improved; weeds are more of a problem one year than another; some years are dry and some are wet; lifting operations are often prolonged by bad weather. These are a few of the many reasons why an average unit cost for all species is not too meaningful.

We had all these facts in mind when a cost accounting system was developed for TVA's forest nurseries. Excellent detailed records have always been kept on *overall* expenditures by our Accounting Branch. But these are not broken down into detail by species and operations—the kind of information most helpful to the nurseryman.

The system described in this article supplements the usual accounting practices; it refines cost detail for the nurseryman's special benefit. It is a simple, easily understood system—one that puts the least possible strain on a busy man's time and still gives reliable monetary and man-day costs for each species and for each major operation. The records separate for any given species the cost of seed, seeding, weeding, irrigation, pest control, shipping, etc. For ex-

TABLE 1.—SEEDLING PRODUCTION—TOTAL AND UNIT COSTS BY SPECIES THREE PRODUCTION YEARS[1]

| Species | 1948-49 Production | 1948-49 Total costs | 1948-49 Cost per M | 1949-50 Production | 1949-50 Total costs | 1949-50 Cost per M | 1950-51 Production | 1950-51 Total costs | 1950-51 Cost per M |
|---|---|---|---|---|---|---|---|---|---|
| Loblolly and shortleaf pine | 18,300,450 | $ 88,543.30 | $ 4.83 | 18,350,050 | $ 97,381.62 | $5.30 | 13,122,900 | $ 77,199.63 | $5.88 |
| White pine (1st year) | 3,000,000 | 19,213.96 | 6.40 | 4,000,000 | 17,706.38 | 4.42[2] | 5,000,000 | 17,945.23 | 3.58 |
| Yellow poplar | 215,150 | 2,739.71 | 12.73 | 1,240,450 | 8,679.68 | 6.99 | 1,067,400 | 6,456.89 | 6.04 |
| Black locust | 1,469,850 | 9,031.51 | 6.14 | 1,062,150 | 6,758.95 | 6.36 | 976,350 | 6,401.57 | 6.55 |
| Miscellaneous | 66,250 | 841.63 | 12.70 | 109,433 | 604.92 | 5.52 | 127,725 | 762.86 | 5.97 |
| White pine (2nd year) | 860,300 | 3,693.84 | 4.29 | 3,462,500 | 11,678.28 | 3.37 | 3,659,900 | 13,456.91 | 3.67[2] |
| Lespedeza bicolor | — | — | — | — | — | — | 2,922,000 | 13,988.32 | 4.78 |
| Totals | 23,912,000 | $124,063.95 | | 28,224,583 | $142,809.83 | | 26,876,275 | $136,211.41 | |
| Average unit cost—all species | | | $5.18 | | | $5.05 | | | $5.06 |

[1]All species 1-0 except white pine. Includes both Clinton, Tenn., and Muscle Shoals, Ala., nurseries.
[2]Cost per thousand of producing this crop of 2-0 white pine was thus $8.09

TABLE 2.—ANNUAL COST BY OBJECTS—LOBLOLLY AND SHORTLEAF PINE

| Production year<br>Number trees produced | 1948-49<br>18,300,450 | | 1949-50<br>18,350,050 | | 1950-51<br>13,122,900 | |
|---|---|---|---|---|---|---|
| Costs | Cost per M | Total cost | Cost per M | Total cost | Cost per M | Total cost |
| Direct | | | | | | |
| Labor | | | | | | |
| Seed extraction | $ .053 | $ 976.60 | $ .036 | $ 668.06 | $ .139 | $ 1,834.89 |
| Seeding | .230 | 4,211.00 | .190 | 3,495.05 | .201 | 2,644.50 |
| Weeding, irrigation, pest control | .947 | 17,338.82 | .916 | 16,817.23 | .522 | 6,856.00 |
| Lifting, grading, bundling | 1.032 | 18,892.04 | .959 | 17,603.95 | 1.175 | 15,427.92 |
| Shipping | .007 | 144.81 | .001 | 28.46 | .023 | 305.21 |
| Total direct labor costs | 2.271 | 41,563.27 | 2.104 | 38,612.75 | 2.062 | 27,068.52 |
| Materials | | | | | | |
| Seed | .346 | 6,349.80 | .728 | 13,362.64 | .905 | 11,878.57 |
| Other | .005 | 108.70 | .007 | 146.10 | .012 | 163.00 |
| Total cost of materials | .352 | 6,458.50 | .736 | 13,508.74 | .917 | 12,041.57 |
| Total direct costs | 2.624 | 48,021.77 | 2.840 | 52,121.49 | 2.980 | 39,110.09 |
| Indirect | | | | | | |
| Labor | | | | | | |
| Soil preparation | .044 | 822.90 | .051 | 949.76 | .059 | 777.37 |
| General maintenance | .189 | 3,464.96 | .157 | 2,899.25 | .128 | 1,687.06 |
| Other | .042 | 786.03 | .064 | 1,159.30 | .072 | 947.99 |
| Total indirect labor costs | .277 | 5,073.89 | .272 | 5,008.31 | .260 | 3,412.42 |
| Overhead | | | | | | |
| Annual salaries | 1.140 | 20,874.44 | 1.181 | 21,675.61 | 1.381 | 18,133.81 |
| Shipping materials | .059 | 1,096.69 | .123 | 2,268.99 | .076 | 1,001.05 |
| Fertilizer | .028 | 522.18 | .041 | 767.49 | .060 | 792.10 |
| Herbicides, other material | .349 | 6,395.50 | .452 | 8,294.88 | .476 | 6,251.56 |
| Transportation, communication, miscellaneous | .176 | 3,226.99 | .209 | 3,843.57 | .425 | 5,581.27 |
| Depreciation | .182 | 3,331.84 | .185 | 3,401.28 | .222 | 2,917.33 |
| Total overhead costs | 1.936 | 35,447.64 | 2.193 | 40,251.82 | 2.642 | 34,677.12 |
| Total indirect costs | 2.214 | 40,521.53 | 2.466 | 45,260.13 | 2.902 | 38,089.54 |
| Total | $4.838 | $88,543.30 | $5.306 | $97,381.62 | $5.882 | $77,199.63 |

ample, if we know precisely how much it costs to weed shortleaf pine, we are in a better position to do something about reducing the cost of such weeding. For program planning and budgeting the system enables us to predict costs two years ahead.

The system developed in cooperation with TVA's accountants has worked very well during the past four years. It superimposes a production year on parts of two fiscal years. The production year is April 1 to March 31, the fiscal year July 1 to June 30.

The nurseryman makes detailed cost entries daily and monthly on prepared forms. The Accounting Branch supplies data from its ledger accounts once a month. Three basic forms are involved. One is kept daily.—*Payroll Analysis.* The other two are compiled once a month. These are titled *Indirect Expense of Entire Nursery Operation* and *Direct Expense by Species.*[1] Charges are made against a particular species in every possible instance.

All labor time except that of the superintendent and assistant superintendent is entered daily on the *Payroll Analysis* form. Wherever possible, it is charged to a single species. If this is not possible, it goes into one of the miscellaneous columns. For hourly labor, the foreman makes the entries; annual employees make their own. This makes bookkeeping easier. At the end of the month hourly entries are totaled, converted to dollars, and checked against the Accounting Branch's ledger sheet fiscal controls.

Expenses other than labor are entered monthly on one of the expense forms. Here too, the charge is made to a specific species if possible. For example, if we purchase shade frames (used only for white pine production), their cost is charged to white pine on the *Direct Expense by Species* form. Costs that cannot be charged to a single species—shipping materials, cover crop fertilizer, herbicides, transportation, communication, etc.—are entered on the form that covers indirect expense of the entire nursery operation. Salaries of the superintendent and assistant superintendent are also entered monthly on this form. Salaries and wages of employees using the *Daily Payroll Analysis* form are entered as monthly totals on the applicable monthly form.

At the end of March the monthly forms are totaled for the production year. This provides a total of direct costs for each species and a total indirect expense for the entire nursery operation. The total indirect expense is then prorated to each species on the basis of the proportion of that species to total nursery production. By adding the prorated indirect costs to the direct costs, the total cost of production by species for the years is obtained. Unit costs are then a simple matter.

Thus *all* costs of nursery operation *including* depreciation of capital assets (land, buildings, equipment) are included and reflected in the total and unit costs. Totals for the nursery year are

[1] For copies of forms write to the Director, Division of Forestry Relations, Tennessee Valley Authority, Norris, Tenn.

TABLE 3.—THREE YEAR CUMULATIVE AVERAGE—LOBLOLLY AND SHORTLEAF PINE

| Production year<br>Cumulative number produced | 1948-49<br>18,300,450 | | 1948-49 and 1949-50<br>36,650,500 | | 1948-49, 1949-50, and 1950-51<br>49, 773,400 | |
|---|---|---|---|---|---|---|
| Costs | Costs per M | Total cost | Two year average cost per M | Cumulative Total cost | Three year average cost per M | Cumulative Total cost |
| Direct | | | | | | |
| Labor | | | | | | |
| Seed extraction | $ .053 | $ 976.60 | $ .044 | $ 1,644.66 | $ .069 | $ 3,479.55 |
| Seeding | .230 | 4,211.00 | .210 | 7,706.05 | .207 | 10,350.55 |
| Weeding, irrigation, pest control | .947 | 17,338.82 | .930 | 34,156.05 | .823 | 41,012.05 |
| Lifting, grading, bundling | 1.032 | 18,892.04 | .995 | 36,495.99 | 1.043 | 51,923.91 |
| Shipping | .007 | 144.81 | .004 | 173.27 | .009 | 478.48 |
| Total direct labor costs | 2.271 | 41,563.27 | 2.187 | 80,176.02 | 2.154 | 107,244.54 |
| Materials | | | | | | |
| Seed | .346 | 6,349.80 | .537 | 19,712.44 | .634 | 31,591.01 |
| Other | .005 | 108.70 | .006 | 254.80 | .008 | 417.80 |
| Total cost of materials | .352 | 6,458.50 | .544 | 19,967.24 | .643 | 32,008.81 |
| Total direct costs | 2.624 | 48,021.77 | 2.732 | 100,143.26 | 2.797 | 139,253.35 |
| Indirect | | | | | | |
| Labor | | | | | | |
| Soil preparation | .044 | 822.90 | .048 | 1,772.66 | .051 | 2,550.03 |
| General maintenance | .189 | 3,464.96 | .173 | 6,364.21 | .161 | 8,051.27 |
| Other | .042 | 786.03 | .053 | 1,945.33 | .058 | 2,893.32 |
| Total indirect labor costs | .277 | 5,073.89 | .275 | 10,082.20 | .271 | 13,494.62 |
| Overhead | | | | | | |
| Annual salaries | 1.140 | 20,874.44 | 1.160 | 42,550.05 | 1.219 | 60,683.86 |
| Shipping materials | .059 | 1,096.69 | .091 | 3,365.68 | .087 | 4,366.73 |
| Fertilizer | .028 | 522.18 | .035 | 1,289.67 | .041 | 2,081,77 |
| Herbicides, other material | .349 | 6,395.50 | .400 | 14,690.38 | .420 | 20,941.94 |
| Transportation, communication, miscellaneous | .176 | 3,226.99 | .192 | 7,070.56 | .254 | 12,651.83 |
| Depreciation | .182 | 3,331.84 | .183 | 6,733.12 | .193 | 9,650.45 |
| Total overhead costs | 1.936 | 35,447.64 | 2.065 | 75,699.46 | 2.217 | 110,376.58 |
| Total indirect costs | 2.214 | 40,521.53 | 2.340 | 85,781.66 | 2.488 | 123,871.20 |
| Total | $4.838 | $88,543.30 | $5.072 | $185,924.92 | $5.286 | $263,124.55 |

checked against Accounting Branch controls for the same twelve months to insure complete accuracy.

Table 1 lists for TVA's two nurseries, the total and unit costs by species for three production years. Table 2 shows for the same three years a detailed breakdown of costs for shortleaf and loblolly pine by objects. Table 3 carries this breakdown one step further and shows cumulative totals and averages for each operation. Over a number of years, these are the figures that give the most reliable information. They are the ones that can be projected into the future with a fair degree of safety. It is a simple matter to convert dollars into man-days by dividing labor costs by the prevailing rate.

Each nursery typically employs as permanent staff a superintendent ($5,150 to $6,000), an assistant superintendent or trainee ($4,350 to $5,150), a foreman ($3,600 to $4,350), and four forestry aides ($2,500 to $3,150). Hourly labor rate in 1948 was 85 cents; by 1951 it had increased to $1.15.

Some nurserymen will object to this system of cost accounting because materials that are used more than one year are charged against a single crop. Why, for example, should burlap and shade frames, which have a service life of several years, be charged entirely to one year's production? Current crops benefit from such expenditures charged to previous crops. Over a period of years these tend to compensate and the cumulative unit cost figures reflect a valid spread. Unless this is done, unit cost figures for a given year could not be computed until several more years had elapsed. The need is for a fairly accurate *current* cost information—not *perfect* costs six or eight years later.

Admittedly this system is not perfect. But it is simple; it is reasonably precise; and an accountant is not needed on the nursery staff to make it work.

# An Answer to Forest Fire Prevention and Control in Anthracite Coal Fields

**Samuel S. Cobb**
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PROBLEM AREAS in forest fire prevention and control call for concentration of effort, and often new approaches. The need for such concentration and for the development of special procedures in the anthracite coal fields of Pennsylvania has led to a combined educational program and increased preparedness for one of Pennsylvania's most acute forest fire situations.

By 1939, the fire prevention and control organization of Pennsylvania, under George Wirt, then chief of the Division of Protection, Pennsylvania Department of Forest and Waters, and his assistant, now chief, Horace Rowland, had drastically reduced forest fire occurrence and losses over much of the state. Most of the fires then occurring were in the Schuylkill, Luzerne, Lackawanna, Northumberland, and Carbon counties, comprising the anthracite coal fields. A compilation of all townships averaging 10 or more fires a year during the preceding five years was made. Over half of these townships were in the five counties mentioned above.

During the spring fire season of 1940, eight young foresters were assigned to cover units of from two to four of these townships. These men studied the fires that occurred in order to determine origin, possible prevention measures, and the efficiency of the department's fire control organization.

Out of the 48 townships averaging 10 or more fires a year, nine were located in Luzerne County south of the Susquehanna River. Of these nine, three ranked in the first ten, and two of them topped the list. This area now comprises the Lower Luzerne Inspector Division (Fig. 1) of the Wyoming Forest District, and is subdivided into three units with headquarters at Freeland, Mt. Top, and Wilkes-Barre.

This article illustrates the methods used to reduce the fire occurrence in the nine problem, and adjacent townships in the Lower Luzerne Division.

## The County

Lower Luzerne County is an area of 228,394 acres, of which 165 711 acres, or 72 percent is forest land. Most of the timber consists of young, second growth oak-pine forest that has succeeded the earlier scrub oak. There are considerable areas of scrub oak barren.

About 70 percent of the area is high, windswept plateau land, the remainder consisting of river and stream valley.

Extensive urban areas dominate in the Wyoming Valley, extending from Wilkes-Barre to Nanticoke, and in the southern portion in the Hazleton-Freeland complex. There are numerous smaller agricultural and mining communities, and all through the forested areas are the homes of people who have been migrating to the country, mainly during the past fifteen years. The population of the area is in excess of 300,000, largely centered in the urban areas.

## The Problem

The problem that existed in the Lower Luzerne area is shown in Table 1. In 1940, the nine townships listed accounted for all but 20 of the 376 fires, the remainder being scattered over the nine less hazardous townships that complete the division. An examination of the four year average, 1941-44 (Table 1), shows that this pattern continued, with an average of 212 fires per year out of 243. This indicated that, even as the number of fires was reduced, the problem townships continued to produce most of the fires.

The last two columns of Table 1 show that in ten years the fire occurrence both in the nine townships and in the division as a whole has been reduced by about 90 percent.

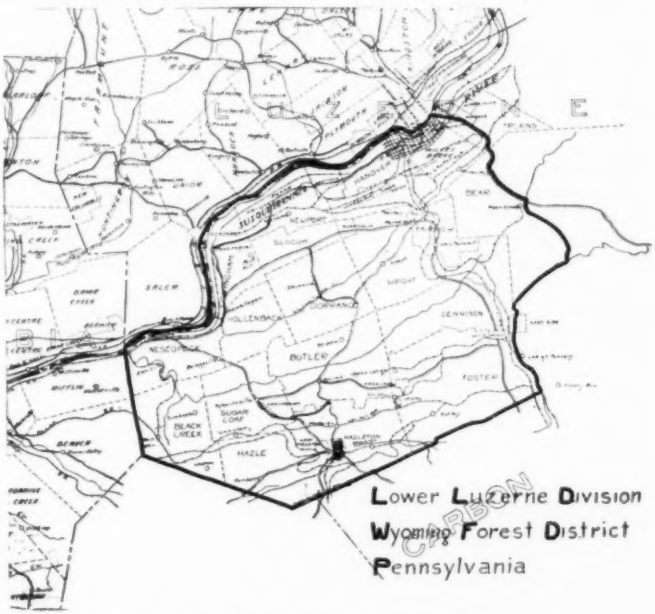


FIG. 1.—Location of Lower Luzerne Division.

TABLE 1.—FIRE OCCURRENCE IN PROBLEM TOWNSHIPS

| Division | Township | Number of fires | | | |
|---|---|---|---|---|---|
| | | 1940 | Average per year 1941-44 | 1949 | 1950 |
| Freeland | Hazle | 130 | 57 | 7 | 1 |
| | Foster | 62 | 35 | 3 | 5 |
| | Butler | 27 | 8 | 1 | 5 |
| Wilkes-Barre | Hanover | 43 | 47 | 2 | 2 |
| | Newport | 29 | 17 | 0 | 2 |
| | Wilkes-Barre | 18 | 15 | 0 | 2 |
| Mt. Top | Dennison | 10 | 17 | 3 | 3 |
| | Fairview | 14 | 11 | 10 | 6 |
| | Wright | 13 | 5 | 0 | 0 |
| Total fires — Nine townships | | 346 | 212 | 26 | 26 |
| Total fires — Lower Luzerne County | | 376 | 243 | 33 | 38 |

## The Hazards

Causes of forest fires in the Lower Luzerne Area can be generalized into the following classifications:

1. Careless smokers
2. Children
3. Trash and brush burners.
4. Railroads
5. Public dumps and trash disposal areas
6. Incendiaries

Add to these causal agencies the large area of brush and forest, the fact that the woods extend to the back yards of the cities and towns, the thousands of homes scattered throughout the forested areas; the high inflamability of the fuel, and the prevalence of high winds throughout the fire season, and one has the ingredients of many serious fires.

## The Solution

A study of the fire spot maps for a period of years revealed that, within the problem townships, the bulk of the fires were occurring in certain well defined areas. Using this information as a base, a study of the past fires in these areas by causes, gave the foresters and inspectors a picture of the hazards that were producing these burns.

With the problem narrowed to certain townships, further narrowed to limited portions of these townships, and a record of the agencies responsible for the fires, it was possible to devise positive action to eliminate a large portion of the trouble.

Four specific means of attacking the sources of fire were available, as follows:

1. An intensive and sustained educational program, aimed at both the child in school and the adults at home.

2. The elimination of certain hazards such as at railroads, dumps, problem villages, recreational areas, etc. by means of safety strips burned out annually.

3. Law enforcement through the collection of costs wherever responsibility could be placed, and court action against incendiaries. An increased effort to place responsibility for all fires.

4. A revision of the fire control organization used in the problem areas, to provide a unit that could hit an incipient fire while it was small, and very often before it reached a forested area. Basically this involved the reduction of getaway and travel time of the suppression unit to the bare minimum, consistent wth safe driving. The unit involved has become known as the smokechasers.

## Smokechasing

Prior to 1945, smokechasing as such had been practiced by individual inspectors, and by units known as "paid crews."

The present system has resulted from the availability in the last five years, of two items that had previously been restricted, namely the pickup truck in sufficient quantities, and funds for paying fire control personnel for time other than that spent on actual fire control. Previously, reliance had to be placed on the warden and his crew, called out and paid for only after the fire had started.

The smokechaser system as used in the Wyoming District operates as follows:

*Personnel.*—The men employed as smokechasers are selected about two weeks to a month before the opening of the spring work season. As far as possible, the same men are employed each season, but because of the temporary nature of the work, turnover is rather high. The men are selected from those available on the basis of physical condition, mental alertness, and apparent interest in conservation.

*Pre-season work.* — Employment begins the later part of March or early April. The work during this period consists of the maintenance and burning of safety strips; repair and maintenance of tools, equipment, and station or tower facilities; educational work distributing literature and posters; repairing signs; and training in fire control techniques. Employment in the fall is confined to periods of fire danger and varies from year to year.

*Fire control work.*—The basic job of the smokechaser is forest fire control. Here he becomes the arm of the fire inspector. There are three factors that determine the effectiveness of a fire fighting organization once a fire starts. They are:

1. Discovery and report time.
2. Get away and travel time.
3. Extinction time including mop up.

Item 1 is a matter handled by the tower system, although in high frequency fire areas, smokechasers stationed at strategic points of vantage serve as supplementary observers, often picking up local fires before they are visible to the towers, thus gaining additional minutes in discovery time.

Item 2 is the key to the effectiveness of the smokechaser system in the control of fires and possible sources of fire. By being on standby, with equipment and tools on a pickup truck, the smokechaser unit is ready to go within a minute after the report is received (Fig. 2). By contrast, it is seldom possible to have a warden crew rounded up and moving toward the fire in less

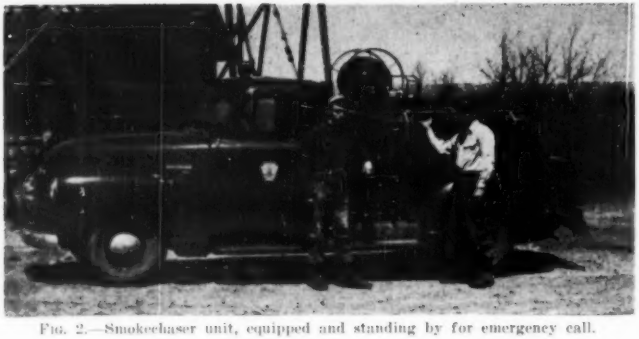

FIG. 2.—Smokechaser unit, equipped and standing by for emergency call.

than fifteen minutes; generally the get away time is much longer.

Item 3 is affected favorably in the case of a smokechaser unit. Most blazes are attacked shortly after inception by a team that is trained in control tactics and tool use far beyond the capabilities of the average crew members. This ability is developed both in pre-season training and through repeated experience on fires under direction of an experienced inspector. It results in rapid, effective extinction of most fires within the period of time normally required to round up a crew and get it to a fire.

In the Lower Luzerne Area, smokechaser units of two or three men are stationed at four points throughout the area, one at the Hazleton Inspector Station which serves as an auxiliary tower, one at the Freeland Tower, one at Mt. Top, and one on a high point in the Wyoming Valley west of Wilkes-Barre. Each unit is supervised by an inspector, who works with the unit, or separately as the seriousness of burning conditions dictate. During critical periods, additional strength is recruited.

At the first sign of smoke in any area where there is a possibility of spread to a forested area, and where the smoke cannot be immediately identified as harmless, the smokechaser unit nearest the smoke is dispatched at once. Operating along familiar routes of travel, this unit is able to reach the smoke within a short period of time. On arrival, if the smoke is an actual or potential fire, the leader of the unit sizes up the job and takes action as follows:

1. If his unit is adequate he makes his attack at once and controls the fire.
2. If the job exceeds the abilities of his unit, he advises the inspector by telephone or radio *at once*, then takes such action as he can to contain the fire until help arrives. If such help is in crew form, he immediately turns the fire over to the incoming warden, with information regarding the fire and the surrounding terrain. The unit then returns to headquarters.
3. On leaving an extinguished fire, or one turned over to a warden, he immediately contacts the inspector and advises him accordingly.
4. The unit is then either returned to the operational headquarters, or if necessary, dispatched to a new smoke.

The smokechaser unit is able to complete control unaided on 75 percent of all fires attacked. This is due to the shortened periods of getaway, travel, and attack; to the training and experience factor; and to the use of firefighting techniques that are not possible on crew-size fires. Principally these techniques are the use of water in the complete control of the blaze. Fires smaller than ¼ acre can normally be extinguished with water alone.

FIG. 3.—Constant contact with inspector or dispatcher is essential to smokechaser effectiveness.

The smokechaser units carry an adequate supply of spray tanks on the truck to permit the use of water beyond the amounts available to warden crews on fires of larger size.

## Observations on the Use of Smokechasers

a. Training of personnel is essential. Through training and experience these men must become "hot shot" units. Lacking this, they are of little value.

b. The critical element in the success of these units lies in maintenance of constant contact with the inspector or dispatcher. Prolonged periods without contact opens the area protected to the danger of other serious fires. A smokechaser unit that ties itself down for long periods, on small areas is not fulfilling its function. In practice, contact except in very inaccessible spots, should be made every 20 to 30 minutes, oftener if possible (Fig. 3).

c. Except during periods of low burning index, any smoke that cannot be reached within 20 minutes cannot be controlled by a smokechaser unit without an extended work period beyond the safety limit, and must often be turned over to a crew for final control. It is better to hold the smokechaser unit under these conditions, and dispatch a crew, unless control action prior to the crew's arrival will save valuable forest lands.

d. Under extreme hazard conditions, a smokechaser unit cannot effect control unless it arrives at the smoke within a very few minutes. Under such conditions, it is the practice to have warden crews alerted for rapid dispatch to guard against a disastrous fire.

e. Smokechaser units, by rapid travel, are often able to determine causes, which would be impossible after the fire gains headway. From this, the organization gains a more accurate picture of fire causes and hazards, and is able to establish responsibility.

f. Smokechaser units, by running down all possible fires, real or false, are able to do an effective educational job. They reach the responsible person while he is still on the ground. Debris and trash burners are saved the fate of starting forest or brush fires and are instructed on the best times and methods of burning. Smokers are warned, and made aware of the possibility of fire and of the organization guarding against it. Children are apprehended, and corrective action can be taken through the parents.

g. The danger to the incendiary in the rapid arrival of a control unit is obvious, and he becomes discouraged, even when not apprehended, by the rapidity with which his "set" is extinguished.

TABLE 2.—RECORD OF "SMOKES" HANDLED BY SMOKECHASERS IN 1949

| Division | Number of spots handled | Average time from report to extinction | Average area burned over |
|---|---|---|---|
| | | *Minutes* | *Acres* |
| Freeland | 82 | 45 | 0.25 |
| Wilkes-Barre | 17 | 52 | 1.65 |
| Mt. Top | 5 | 73 | 0.75 |
| Totals | 104 | 48 | 0.50 |

46 of these fires controlled in 30 min. or less (44%)
65 of these fires controlled in 45 min. or less (63%)
80 of these fires controlled in 60 min. or less (77%)

## Summary

That the system as outlined and explained above is effective is attested by the figures in Table 2. This table covers all smokes handled by the smokechaser units in the Lower Luzerne Area in 1949. The majority of these smokes were not true forest fires, but fell within one of the following categories:

a. Smoke from burning operations under control.

b. Brush or grass fires not threatening forest areas.

c. Brush or grass areas within urban or industrial areas, not the responsibility of the department.

d. Brush or grass fires threatening forested areas.

For the department as a whole crew fires of only 1 to 10 acres require an average of 33 minutes from the time the warden receives the report until he arrives at the fire. A study of eight crew fires of less than 10 acres, that occurred in the same area in 1949, shows an average time lapse of 145 minutes for extinction of the fire after arrival, or a total of 178 minutes elapsed time from report to extinction of fires where crews are required.

The smokechaser system is not a cure for all forest fires. Combined with a sound prevention program, it is a very effective tool to reduce both the size and number of fires in a given area. It cannot be used everywhere, and should never be considered as a substitute for a good fire warden organization. The backbone of Pennsylvania's forest fire control program has been and will be the forest fire warden and his crew.

Used in limited areas of high fire frequency, high hazard, and easy accessibility, the smokechaser unit is a tremendously effective tool.

# Slash Pine Planting Makes Remarkable Growth

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THE RELOCATION of a state highway that crosses the Richloam Unit of the Brooksville, Fla., Land Utilization Project of the Soil Conservation Service, resulted in the removal of a part of a slash pine planting 14 years old. This planting was located on low, imperfectly drained, flatwoods land of Leon, Rex, and Ona soils, the chief characteristics of which are their gray to black coloration and their underlying hardpan of sticky, sandy clay.

The cutting presented a good opportunity to obtain very accurate information on the growth of the planting. In addition, an unusually fine opportunity was afforded to check the "basal area" method of estimating standing timber with the actual volume piled and measured following a clear cut. Therefore, prior to the cutting of the plantation, four 1/10-acre plots were laid out. The breast high diameter of all live trees in each plot was measured in inches and tenths to determine the average.

Average height was determined by measuring two rows of trees at right angles to each other across the center of each plot, using an Abney hand level. Then the total cubic feet to a 2-inch top on each plot was computed. This total was divided by 90 to arrive at the number of piled cords on each plot. In addition, on Plot No. 4, the number of posts (7 feet long with a 3-inch top) was estimated. Photographs also were taken before and after the cutting was done. The four plots were then cut, the wood was piled and measured, and the posts were counted.

Plot No. 1 was clear-cut for pulpwood and the remaining tops that were too small for pulpwood were cut into posts (Figs. 1 and 2).

Plot No. 2 was thinned for pulpwood and posts were cut from tops (Figs. 3 and 4).

Plot No. 3 was clear-cut for pulpwood only (Fig. 5), disregarding all sticks too small for pulpwood.

Plot No. 4 was clear-cut for posts in accordance with a local post-buyer's specifications and prices. These posts were cut into lengths varying from 7 to 11 feet and with a minimum top diameter of 3 inches at the small end.

FIG. 1.—Plot 1 prior to cutting.

FIG. 2.—Plot 1 after cutting of pulpwood and posts.

FIG. 3.—Plot 2 prior to thinning.

FIG. 4.—Plot 2 after thinning for pulpwood and posts.

FIG. 5.—Plot 3, clear-cut for pulpwood.

FIG. 6.—Plot 4 clear-cut for posts.

The information obtained is tabulated below:

| | Estimate before cutting | | | | | Measurements, counts, values after cutting | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trees | Ave. | | Cords[1] or posts[2] | | Ave. | Cords | Posts per acre | | | | Value |
| Plot | per acre | d.b.h. | Height | per acre | | ht. | per acre | 7 ft. | 8 ft. | 10 ft. | 11 ft. | Stumpage | Delivered |
| 1 | 720 | 6.0 | 43 | 30 | 2,370 | 45 | 28 | 1,040[3] | — | — | — | $164.00 | $440.00 |
| 2 | 660 | 6.0 | 42 | 27 | — | 45 | 10 | 440[3] | — | — | — | 70.00 | 164.00 |
| 3 | 590 | 6.6 | 45 | 31 | — | 47 | 31 | — | — | — | — | 124.00 | 372.00 |
| 4 | 680 | 6.0 | 43 | 29 | 2,240 | 45 | — | 1,150 | 240 | 130 | 660 | 248.00 | 497.90 |

[1]Standard cords. [2]Posts 7 feet long with 3 inch top diameter inside bark. [3]Posts are in addition to cords.

As the trees were cut, actual height (length) measurements were made on 50 dominant and co-dominant trees, some on each of the four plots. The maximum height found was 53 feet. The heights thus obtained were averaged and are shown in the table. The length to a 4-, 3- and 2-inch top diameter was also measured on these 50 trees. The lengths to the various diameters averaged as follows:

25 feet to a 4-inch top
32 feet to a 3-inch top
38 feet to a 2-inch top

Thus the trees in this plantation averaged about five sticks of pulpwood per tree, or four posts to a 3-inch top, or about five to a 2-inch top.

A summarization of the information obtained is outlined below:

1. The production of about 31 cords per acre in 14 years, or about 2.2 cords per acre per year; or in terms of posts, about 170 per acre per year.

2. Comparison of the value of different available products showed that cutting the trees into graded posts yielded the greatest return—almost $500 per acre delivered. The combination of cutting for posts and pulpwood yielded the next highest return and the cutting for pulpwood only, the lowest.

3. The thinning in Plot 2 which removed about one-third of the total volume in the stand, indicates the possibilities for good returns from periodic thinnings in young stands, leaving the best trees to grow into saw timber, poles, and piling.

4. The price received for delivered products, as compared to the price for stumpage, shows the owner's opportunity for income in harvesting and delivering forest products.

5. The comparison of the estimate of the standing timber volume and the clear-cut volume, all reduced to cords, reveals:

| | Estimated (to a 2-in. top) | Actual after clear-cut (to a 3-4-in. top) |
|---|---|---|
| Plot 1 .... | 30 cords | 35 cords |
| Plot 3 .... | 31 cords | 31 cords |

In Plot 4 the post estimate, in terms of posts 7-feet long was 2,240, and the actual was 2,560 per acre.

6. Planting of slash pine proved to be not only good land use but also good farm business.

The results of the slash pine planting indicate the fine opportunity that a farmer has to add to his farm income by planting pine trees on his land not needed for crops or pasture. It also demonstrates the amount of wood that land will produce over the years, and the value of the products.

On a selective cutting, timber of this type is selling for $3 a cord for pulpwood on the stump. Posts cut from the plots brought stumpage prices varying from 2 cents each for 7-foot lengths with a minimum top diameter of 2¾ inches, to 9 cents each for a specialty item 11 feet in length and averaging 5½ inches in diameter.

On a clear cutting, pulpwood will bring $4 a cord on the stump and posts will bring from 3 to 10 cents each.

Pulpwood is selling for $13 a cord loaded on the car, and posts are bringing from 5 cents for a 7-foot stick, 2¾-inch top, to 35 cents for the specialty post.

The land on which these trees grew is ordinarily recommended for cultivation. However, when it it considered that extensive water control, cover crops, fertilization, lime, and special management is necessary to retain these soils in cultivation indefinitely, the reason for planting them to trees becomes apparent. Since the site is better than ordinarily recommended for trees, the volume growth has been slightly better than could be expected on the poorer lands usually recommended for timber production. At the same time the results clearly show that the returns per acre from timber can be expected to approximate those derived from cultivated crops, and management is much less complicated and the chance of soil erosion and soil fertility depletion is greatly reduced.

## Respect for Education Not New

"I know no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education."

THOMAS JEFFERSON

# Mechanical Preparation of Seedbeds for Converting Oak-Pine Stands to Pine

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*Mechanical ripping or disking was found to be effective for preparing seedbeds favorable for pine in the oak-pine forests of southern New Jersey. However, such treatments are risky because of the uncertainty of catching a good seed crop. And, in the authors' experiments, none of the treatments ensured dominance of pines over sprouts.*

FOR 30 YEARS foresters in southern New Jersey have sought a practical method for converting mixtures of oak sprouts and pitch or shortleaf pine to pine stands of seedling origin. Early attempts to do this were by planting (*3*). By 1935 it had become apparent that the job might be done better by encouraging natural reproduction. The Allegheny Forest Experiment Station, testing methods of preparing seedbeds, found that digging and scalping greatly increased the natural establishment of pine seedlings (*4*).

The effect of these seedbed treatments did not last long, because the overwood was not cut. Observations indicated that light—as well as a favorable seedbed—was essential for satisfactory establishment and growth of pine seedlings. So, in 1939 an experiment was started to test different methods of seedbed preparation after everything had been cut except seed trees.

Six seedbed treatments were used after cutting, as follows:

| Mechanical treatment | Slash disposal |
|---|---|
| 1. Ripping | Piling & burning |
| 2. Disking | Piling & burning |
| 3. Ripping | Broadcast burning |
| 4. Disking | Broadcast burning |
| 5. None | Broadcast burning |
| 6. None | Lopping & scattering |

(As a check on the effectiveness of the heavy cutting used in the treatments, the experiment also included control plots where pines were reduced to the same number of seed trees used on the treated plots; the resulting slash was removed, but no further work was done. Since the pines formed such a small proportion of the stand, the cutting of extra pines had little effect on seedbed and light conditions in the control plots.)

This experiment was carried on in two areas, the Lebanon State Forest in Burlington and Ocean Counties and the Belleplain State Forest in Cape May County. In each area, two blocks of plots were used. The first plots were in two-aged stands where older pines formed a broken overstory and the understory was chiefly of oak sprouts. The second were in even-aged stands where the oaks and pines were nearly the same size.

For each treatment, eight plots were used, two in each of the four blocks. In the two-aged stands, the plots were ½ acre in size, in the even-aged stands 1 acre.

## Treatments

*Cutting.*—The cutting was designed to provide as uniform seed sources as possible. About ten pine seed trees per acre were left standing. Spacing was considered most important in the selection of seed trees, but size and past cone production were also considered. Shortleaf pines were chosen for seed trees wherever possible, but on some plots nearly all seed trees were pitch pines.

Before cutting, the pines ranged in number from 40 to 65 per acre, in size from 1 inch to 16 inches d.b.h. The stand conditions after cutting are shown in Table 1.

Cutting was begun in May 1939. It was completed on all plots by the spring of 1940.

*Disposal of slash.*—The slash was burned between December 1939 and spring of 1940.

*Mechanical treatments.*—A road ripper, having two teeth set 48 inches apart, was used to expose mineral soil on the ripped plots. The ripping was done so as to make furrows about 24 inches apart (Fig. 1).

A 6-foot disk harrow, having eight 24-inch disks, was used in the disking. Plots were disked only once. Both the road ripper and the disk harrow were drawn by a 35-horse power crawler tractor.

The machine treatments were made in the Lebanon plots in March 1940 and in the Belleplain plots in September-October 1940. Since a growing season intervened between cutting and mechanical treatment in the Belleplain plots, all hardwood sprouts in those plots were cut before treatment—both to facilitate the use of machinery and to retain as much uniformity in the plots as possible.

Sprouting was vigorous after the machine treatments; so heavy cutting of sprouts seemed advisable in some of the plots. These cuttings were made in one plot of each treatment in each block, in August 1941. They were repeated in the Lebanon two-aged stand in November 1942.

TABLE 1.—STAND CONDITIONS AFTER CUTTING

| Stand | | Pines | | Oaks | | |
|---|---|---|---|---|---|---|
| | | Per acre | Range in d.b.h. | Per acre | Range in d.b.h. | Average d.b.h. |
| | | *Number* | *Inches* | *Number* | *Inches* | *Inches* |
| *Lebanon plots* | | | | | | |
| Two-aged | Treated | 11 | 6-12 | 0 | — | |
| | Control | 12 | 5-11 | 1,092 | 1-5 | 2 |
| Even-aged | Treated | 10 | 6-13 | 0 | — | |
| | Control | 10 | 7-12 | 441 | 1-12 | 6 |
| *Belleplain plots* | | | | | | |
| Two-aged | Treated | 12 | 4-13 | 0 | — | |
| | Control | 13 | 5-13 | 497 | 1-6 | 3 |
| Even-aged | Treated | 10 | 4-13 | 0 | — | |
| | Control | 10 | 5-11 | 350 | 1-11 | 5 |
| All plots (average) | Treated | 11 | 4-13 | 0 | — | |
| | Control | 11 | 5-13 | 595 | 1-12 | 4 |

### Factors Affecting Results

*Seed crops.*—The 1940 seed crop was the first that could have supplied seed for new reproduction on all the treated plots. Earlier crops would have been ineffective on most of the treated plots because of subsequent burning of slash and use of machinery.

Observations indicated that a partial seed crop was produced in the Belleplain plots in 1940, particularly in the two-aged stand, but that very little seed was borne by trees of the Lebanon plots. These observations were substantiated by seedling tallies in 1941. On 420 milacres in each area, 298 seedlings of 1941 origin were tallied in the Belleplain two-aged stand, 142 in the Belleplain even-aged stand, 14 in the Lebanon even-aged stand, and 1 in the Lebanon two-aged stand.

The 1941 seed crop was better. Consequently additional pine reproduction started in 1942. However, this only partly restocked the Lebanon blocks.

Although the seed crops between 1942 and 1946 were not good, they did provide some seed for additional reproduction. But this seed was undoubtedly less effective than earlier crops in establishing seedlings because of changes in seedbed conditions after the treatments.

*Changes in seedbed conditions.*—The effect of the treatments was relatively short-lived. As vegetation restocked the plots, the seedbeds tended gradually to become uniform. However, the effects were still discernible in spots after 7 years.

Areas where mineral soil had been exposed soon became covered with vegetation, and a forest floor was gradually created. This was increasingly less favorable for the establishment of pine seedlings. Where pine reproduction was not quickly established, shrubs and sprouts from hardwood stumps soon dominated the area (Fig. 2).

Meanwhile, conditions in the plots once covered with litter and slash were also changing. Decay obliterated much of the slash and litter present in 1940, thus creating conditions more favorable for the establishment of pine seedlings. But at the same time, hardwood sprouts, shrubs, and other vegetation were restocking the plots and providing material for the forest floor. Consequently, the forest floor never vanished from these plots, although decay did reduce its depth. Seedbed conditions in these plots were nearly the same in 1947 as in the areas where mineral soil had been exposed.

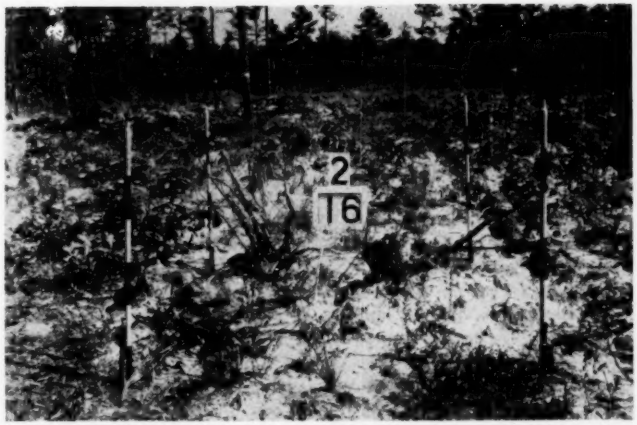


FIG. 1.—A milacre in one of the ripped plots during the summer of 1940. Note the mineral soil exposed, the hardwood stumps uprooted.

FIG. 2.—Typical appearance of the ripped plots in the Lebanon Forest in summer 1948. In 1940 this milacre looked like that shown in Figure 1, but 7 years later it bore only one pine seedling. The poor catch of pines is attributed to poor seed crops during the period when the seedbed was most favorable.

*Deer browsing.*—The deer population varied greatly in the areas used in this study. There were few deer in the Belleplain Forest, but many in the Lebanon Forest. Censuses in 3 years (1938-40) indicated that deer were present in the vicinity of the Lebanon two-aged stand at the rate of 1 to every 50 acres, and in the even-aged stand at the rate of 1 to every 10 acres.

No pines injured by browsing were observed in the 1947 tallies of the Belleplain blocks, but browsing damage was common in the Lebanon areas. There evidence of deer browsing was found on 20 percent of the reproduction in the two-aged stand, and on about 40 percent in the even-aged stand.

The effect of browsing has apparently been much greater on height growth than on mortality. A few severely browsed pines have died, but the usual injuries have resulted in retarding height growth and deforming the trees.

## Results

*Immediate effects.*—All the treatments reduced the amount of advance reproduction.

Ripping, which pulled up some stumps as well as exposed mineral soil, caused the greatest damage. It—with the prior slash disposal—destroyed 80 percent of the pine seedlings already present on the plots. (The two methods of slash disposal used before ripping or disking did not cause measurably different effects on advance and subsequent reproduction.)

Disking eliminated about 60 percent of the advance reproduction. Broadcast burning eliminated 20 percent. Lopping and scattering, the least destructive treatment, eliminated 5 percent.

Losses of advance reproduction by broadcast burning of slash varied appreciably. Differences in age and vigor of the seedlings were the reason for this. Some pitch and shortleaf pines sprouted after the burning, and the sprouts were counted (but separated from seedlings) in our tallies. Young seedlings, particularly those only 1 year old, were completely killed; and seedlings of low vigor generally did not sprout.

*Seedbeds resulting from treatments.*—The treatments brought about considerable differences in seedbed conditions. At the end of the 1941 growing season, mineral soil was exposed on 53 percent of the quadrats in the ripped plots, on 27 percent in the disked plots, on 9 percent in the plots where broadcast burning of slash was the only treatment, and on 2 percent in the plots where slash was lopped and scattered.

The seedbed conditions varied greatly, within plots as well as among plots.

Three kinds of seedbeds were considered in the study: mineral soil, litter, and litter with slash added. As expected, mineral soil provided the best seedbed. Tallies in 1941-42 showed 15 times as many new seedlings on mineral soil as on litter. Slash added to the litter practically precluded the early establishment of pine seedlings. These results are similar to those from other studies in New Jersey and elsewhere (*1, 2, 4*).

These pines need mineral soil or a film-like layer of forest floor to get established on upland sites. Even if seeds germinate in the litter during wet periods, the short taproot developed from the food stored in the seed is usually unable to penetrate the undisturbed forest-floor and get far enough into mineral soil to carry the seedling through dry periods.

Seedlings classed as growing on litter were mostly in spots where the forest floor was thinner than usual. Many were on the edge of spots of mineral soil where the litter was only 1 to 3 leaves deep. Others started in spots where much of the litter had disappeared through the action of wind or fire, leaving a film of twigs and humus less than ½ inch deep. This condition was common in areas where slash had been broadcast-burned.

*New reproduction.*—The number of seedlings that started in 1941 varied greatly among the four experimental areas (or blocks), because of differences in the 1940 seed crop. Ripped areas generally had the greatest amount of new reproduction (Table 2). Disked areas were second. Areas where slash was broadcast-burned had much less, but still more than the untreated control plots. Areas where the slash was lopped and scattered had, on the average, less new reproduction than the control plots.

During the following 6 years (1942-47) the ripped plots continued to show the greatest increase in pine reproduction (Table 3). The disked and broadcast-burned plots were still second and third. The plots where slash had been lopped and scattered made small gains in amount of reproduction, but generally more than the control plots.

In 1947 the average ripped plot had more than 2,600 pines per acre; 83 percent of the milacre quadrats were stocked. Disked and broadcast-burned plots both had about 1,900 pines per acre; 67 and 72 percent respectively of their milacre quadrats were stocked. Plots where slash was lopped and scattered had 48 percent of their quadrats stocked; control plots, 38 percent.

TABLE 2.—NUMBER OF PINE SEEDLINGS PER ACRE (1941 ORIGIN) AT THE END OF THE 1941 GROWING SEASON

| Mechanical treatment | Slash disposal | Lebanon | | Belleplain | |
|---|---|---|---|---|---|
| | | Two-aged stand | Even-aged stand | Two-aged stand | Even-aged stand |
| Ripped | Piled and burned or broadcast-burned | 8 | 42 | 1,817 | 692 |
| Disked | Piled and burned or broadcast-burned | 0 | 50 | 517 | 467 |
| None | Broadcast-burned | 0 | 33 | 150 | 17 |
| None | Lopped and scattered | 0 | 0 | 33 | 33 |
| Control plots, average | | 0 | 16 | 116 | 0 |

TABLE 3.—CHANGE IN TOTAL NUMBER OF PINE SEEDLINGS PER ACRE BETWEEN 1941 AND 1947[1]

| Mechanical treatment | Slash disposal | Lebanon | | Belleplain | |
|---|---|---|---|---|---|
| | | Two-aged stand | Even-aged stand | Two-aged stand | Even-aged stand |
| Ripped | Piled & burned or broadcast-burned | +1,191 | +2,209 | +1,683 | +2,317 |
| Disked | Piled & burned or broadcast-burned | +1,092 | +2,008 | +1,016 | +1,699 |
| None | Broadcast-burned | + 883 | +2,084 | +1,084 | +1,283 |
| None | Lopped & scattered | + 366 | + 567 | + 267 | + 183 |
| Control plots, average | | — 250 | +1,117 | — 100 | — 150 |

[1]Includes advance reproduction as well as seedlings established in 1941 and later.

FIG. 3.—One of the Belleplain plots in the even-aged stand in the spring of 1949. Following the seed tree cutting, this area was disked prior to the 1940 seed fall, and hardwood sprouts were cut in 1941 and 1947.

TABLE 4.—AVERAGE HEIGHT OF TALLEST PINES ON STOCKED MILACRES IN 1947

| Mechanical treatment | Slash disposal | Lebanon | | Belleplain | |
|---|---|---|---|---|---|
| | | Two-aged stand | Even-aged stand | Two-aged stand | Even-aged stand |
| | | *Feet* | | | |
| Ripped | Piled and burned or broadcast-burned | 1.5 | 2.3 | 7.6 | 5.3 |
| Disked | Piled and burned or broadcast-burned | 1.4 | 1.7 | 6.7 | 6.5 |
| None | Broadcast-burned | 4.0 | 1.8 | 8.2 | 6.4 |
| None | Lopped and scattered | 4.9 | 1.4 | 8.0 | 6.9 |
| Control plots, average | | 0.5 | 0.4 | 1.7 | 0.9 |

TABLE 5.—AVERAGE HEIGHT GROWTH OF PINES ON STOCKED MILACRES BETWEEN 1941 AND 1947

| Treatment | Lebanon | | Belleplain | |
|---|---|---|---|---|
| | Two-aged stand | Even-aged stand | Two-aged stand | Even-aged stand |
| | *Feet* | | | |
| Sprouts cut since 1940[1] | 7.0 | 4.3 | 8.9 | 7.8 |
| Sprouts not cut since 1940 | 3.0 | 3.0 | 8.0 | 7.1 |
| All treated plots, average | 5.3 | 3.8 | 8.4 | 7.4 |
| Control plots, average | 0.3 | 0.4 | 1.1 | 0.2 |

[1]In 1941 in all areas; also in 1942 in the Lebanon two-aged stand.

TABLE 6.—DOMINANCE OF PINES ON QUADRATS STOCKED WITH BOTH PINE AND HARDWOODS IN 1947 (IN PERCENTAGE OF DOMINANT TREES[1])

| Mechanical treatment | Slash disposal | Lebanon | | Belleplain | | All areas |
|---|---|---|---|---|---|---|
| | | Two-aged stand | Even-aged stand | Two-aged stand | Even-aged stand | |
| Ripped | Piled and burned or broadcast-burned | 5 | 13 | 63 | 31 | 31 |
| Disked | Piled and burned or broadcast-burned | 5 | 12 | 51 | 47 | 31 |
| None | Broadcast-burned | 19 | 18 | 57 | 41 | 33 |
| None | Lopped and scattered | 24 | 5 | 64 | 37 | 31 |
| All treatments, average | | 11 | 13 | 58 | 40 | 32 |
| Control plots, average | | 0 | 11 | 28 | 0 | 14 |

[1]Not including overstory trees, i.e., pine seed trees in all plots and hardwoods 0.6 inch d.b.h. or larger in the control plots.

*Growth of pine reproduction.* The height of the pine reproduction on the study plots in 1947 is shown in Table 4. Naturally the plots where the advance reproduction was not damaged by ripping and disking show the greatest average heights, since height is generally a reflection of age. Part of the difference in height between the Belleplain and Lebanon plots can be attributed to damage from deer browsing, part to the quicker restocking of the Belleplain areas.

Competition from hardwood sprouts affected the height growth of the pine seedlings. Seedlings grew 0.7-1.3 feet more between 1941 and 1947 in the areas where hardwood sprouts were cut in 1941 (Table 5). In the Lebanon, two-aged stand where hardwood sprouts were cut in both 1941 and 1942, the difference in height growth was 4 feet during the 6 years. Of course the pines on the control plots grew much less than those on the heavily cut plots.

*Dominance of pines.*—None of the treatments tried in this study prevented the sprouting of hardwoods. In 1947 there were about 3,700 hardwood sprouts per acre in most of the heavily cut plots. Only ripping, which uprooted some of the stumps, reduced the hardwood-sprout problem—by about 40 percent—but even in the plots so treated there were still about 2,200 hardwood sprouts per acre in 1947.

These hardwoods are a serious hindrance to obtaining a high proportion of pine in the next crop. Although every treatment except lopping and scattering of slash resulted in more than two-thirds of the quadrats being stocked with pine reproduction by 1947, most of this reproduction was not dominant; it was overtopped by hardwood sprouts (Table 6).

Of course additional cleanings in all plots where machinery or broadcast burning was used will provide a predominantly pine stand from reproduction present in 1947. In 1947-48, after the plot measurements were completed, such a cleaning was made; it was sufficient to give the desired stand

composition in nearly all the Belleplain plots that had been treated with burning or machinery (Fig. 3).

Prior to the 1947-48 cleaning the only place where the pines could form a high proportion of the next crop without further release was in some plots in the Belleplain two-aged stand. There the greater dominance of pine was due to quick restocking.

The dominance of pines over competing hardwoods would be most easily obtained through the use of advance reproduction. For example, in the heavily cut plots of the Belleplain two-aged stand, advance reproduction still living in 1941 was on the average 10.2 feet tall in 1947, reproduction of 1941 origin was 8.3 feet tall, and reproduction starting after 1941 was 3.8 feet tall.

### Conclusion

The results of this study indicate that machinery can be used in preparing seedbeds for pine reproduction, but that good results can be expected only when a fair or better supply of seed will fall on the area within the next year.

Good seed years for pine are relatively rare in southern New Jersey. There was one in 1927, another in 1938, and another in 1947. Observations of cone crops and reproduction in the vicinity of the Lebanon State Forest indicate that in one 14-year period there were seven partial crops and five poor crops when little seed was produced.

Thus, in at least one of every three years the use of machinery would probably give poor results because of poor seed crops. In actual practice an even greater proportion of failures may result because of a combination of relatively poor seed sources and seed crops.

To be successful, machine treatments must also ensure dominance of pines over hardwood sprouts. None of the treatments used in this study was successful in that respect. Because of the relatively poor results and the cost of machine treatments, the authors do not recommend them for general use in the oak-pine stands of southern New Jersey. For accomplishing much the same purposes, prescribed burning before the final harvest cutting has proven far cheaper and more reliable, besides providing other advantages.[1]

[1] See (*2*) and the following:
LITTLE, S., J. P. ALLEN, and E. B. MOORE. Controlled burning as a dual purpose tool of forest management in New Jersey's pine region. Jour. Forestry 46:810-819. 1948.
———, and E. B. MOORE. Effect of prescribed burns and shelterwood cutting on reproduction of shortleaf and pitch pine. Northeast. Forest Expt. Sta. Sta. Paper 35. 1950.

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3. MOORE, E. B. 1939. Forest management in New Jersey. N. J. Dept. Conserv. and Devel.
4. WOOD, O. M. 1939. Reproduction of shortleaf pine following mechanical treatment of the seedbed. Jour. Forestry 37: 813-814.

## Sweetgum Seed is Overrated Flier

Recent observations in southern Arkansas tend to refute the popular belief that sweetgum seed travels through the air for great distances after being released from the parent tree.

Seeds were dropped from a fire tower at heights ranging from 33 to 100 feet, and at wind velocities of 5 to 25 miles per hour. The area surrounding the tower was open and level prairie. In all, twenty-five drops were made, with a quarter of a pound (about 20,000 seeds) being released at each trial. Ten drops were made from 100 feet above ground, nine from 89 feet, three from 61 feet, three from 33 feet.

Ninety-six percent of the seeds that were trapped were within 200 feet of the tower, and most of the remaining 4 percent fell between 200 and 400 feet. The longest flight of any seed that was recovered was 600 feet. Abundant young sweetgum thickets in old fields and under pine overstories have encouraged the legend of much longer flights, but the probability is that many such stands are of sprout origin. On the whole, the pattern of sweetgum seed flight was about the same as that of loblolly pine seed.

These finding have at least two practical applications. Where hardwood control measures are being carried on to favor the pine component of pine-hardwood stands, all seed-bearing sweetgum should be removed from the sand and from a zone 600 feet around them. But where a regeneration cut is being made in sweetgum stands on a good hardwood site, sweetgum seed trees should be spaced not much farther than 100 feet apart. These recommendations are deliberately conservative, since forests reduce wind velocity and impede the flight of seed.

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# Survival and Growth of Forest Plantations in Missouri[1]

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A STATEWIDE PLANTING program was begun in Missouri in 1937. Since that time more than a million forest tree seedlings have been distributed to farmers and other landowners in the state each year. The planting program in Missouri has probably proceeded in much the same fashion as planting programs in other states, but conditions for planting in Missouri are less favorable than they are in many regions The soils in most of the state are heavy, frequently shallow, or underlain with clay pan at shallow depths, and the planting season is usually so wet that the planting job is accomplished with considerable difficulty.

The climate of the state is also one of extremes, and although the winters are not severe, the cold weather that does occur is not accompanied by much snow. Consequently, forest soils are subject to the influence of frequent, rapid, and extreme changes in temperature. In the summer, the soil in most situations is subject to rapid and frequent changes in temperature and in soil moisture content. Because of the difficult climate and soil a high degree of success in planting can probably be achieved only under the most favorable conditions of establishment treatment.

In fact, after 10 years of planting, it seemed that many plantings were unsuccessful and that an attempt should be made to measure the amount of success and to determine the reasons for failure. A study of past plantings also promised to provide a basis for future fundamental forestation research.

In order to realize these objectives, a randomly selected sample of 1,500 plantations was drawn from a list of planters who had obtained trees from the state nursery between 1937 and 1948. To obtain data on 1,419 plantings, however, this original sample had to be supplemented by selective sampling in the field. This was necessary because 1,088 of the original sample of 1,500 were not productive of any positive information in the field. Because of the selective sampling and the bias which accompanied the sampling method, the results of the plantation survey presented here are not subject to statistical evaluation. Nevertheless, most of the data seem to merit interpretation and application to planting programs in the future.

[1]Paper given at a meeting of the Division of Silviculture, Society of American Foresters, Biloxi, Miss., December 14, 1951.

## How Data Were Collected

Field data were obtained by personal interview, by measurement of trees, and by other observations on plots in the plantations. Data obtained by interview were those concerned with the plantation history, such as the condition of stock at the time of planting, planting method used, condition of site at time of planting, and plantation care. Plot data yielded information on the description of the site; survival, growth, and vigor of the trees; presence of insect pests or disease; and signs of misuse of the plantations.

Soil data and macro-climatic data were also collected on plots in plantings where the history was such that the influence of these data upon plantation success would not be confounded by establishment treatment. The analysis of soil and climatic data is not yet complete; consequently, the results presented in this paper have to do primarily with the effect of establishment treatment upon survival and growth.

## Factors that Affected Survival

*Condition of stock.*—The evaluation of condition of stock was based upon six considerations: (1) the opinion of the planter, (2) the dormancy of the stock upon receipt by the planter, (3) the number of days elapsing between arrival of stock and planting, (4) whether stock was kept in the bundle before planting, (5) the number of days stock was held in heeling-in trench before planting, and (6) precautions taken by the planter to assure that the roots of the stock were moist when planted.

The opinion of the planter as to the quality of the stock was based upon his impressions regarding presence of mold in the bundle, whether or not the roots of the trees in the bundle were moist, evidence of root stripping, root to top ratio, etc.

The survival data (Fig. 1 and Table 1) indicate that the field determination of condition of stock was fairly reliable for the good and poor categories but that fair condition of stock could not be determined with as much reliability. Also, it is apparent that poor condition of stock has had a definitely adverse effect upon survival. It is notable, however that planting stock was classified as being in poor condition on only 8.3 percent of the plantations visited, and that poor condition was frequently due to the lack of attention given to the stock after it was received by the planter, or at the distribution center. In some cases stock was left at the county agent's office for several days; in other cases it was kept by the planter from 3 days to 3 weeks in the bundle and then planted with dry roots. The effect of dry roots on condition of stock was particularly marked in the cases of the three species of pine.

*Planting method.*—The excellence of planting method was based upon a consideration of the actual planting method used and the planter. Apparently the reluctance of planters to admit having done a poor job was sufficient in most cases to eliminate any effective measurement of the influence of planting method upon survival. Landowners who had hired the planting job done sometimes described poor planting methods; however, in 85.5

percent of the cases good or fair methods of planting were described. On the 47 plantations where poor planting methods were described, the average survival was lower than the average survival for all plantations and also lower than the average for the plantings where good and fair methods were described (Fig. 2 and Table 2).

*Condition of site.*—Condition of site was regarded as good if the site was adequately prepared for planting by plowing or furrowing and if it was not severely eroded at the time of planting. Condition of site was poor, however, if it was not prepared for planting, and if it was badly eroded at the time of planting. Where condition of site was intermediate between good and poor, plantings were classified as fair. Apparently the hardwoods, except black locust, were most severely affected by poor site condition, whereas the three species of pine show very little effect of condition of site (Fig. 3 and Table 3).

*Plantation care.*—The fourth element of establishment treatment, plantation care, was evaluated on the basis of effective protection from grazing and fire, cultivation, mulching, release from brushy competition by cutting, spraying to control insects or disease, fertilization, and any other intensive treatments which seemed likely to contribute to high survival. A plantation was considered to have had good care when it had been protected adequately from grazing and fire and when it had been given any treatment to control competing vegetation, such as cultivation, mulching, or brush cutting. Fair plantation care was assigned to those plantations where adequate protection but no control of competing vegetation was provided, and poor plantation care was indi-

TABLE 1.—AVERAGE SURVIVAL PERCENT FOR SEVERAL SPECIES AS AFFECTED BY CONDITION OF STOCK

| Species | Condition of Stock | | | | | |
|---|---|---|---|---|---|---|
| | Good | | Fair | | Poor | |
| | Average survival | Plantings examined | Average survival | Plantings examined | Average survival | Plantings examined |
| | *Percent* | *Number* | *Percent* | *Number* | *Percent* | *Number* |
| Shortleaf pine | 45.4 | 208 | 19.2 | 17 | 20.1 | 23 |
| Black locust | 67.2 | 205 | 62.4 | 16 | 50.0 | 14 |
| Ponderosa pine | 26.9 | 104 | 44.2 | 4 | 2.1 | 16 |
| Osage orange | 45.1 | 86 | 27.4 | 13 | 26.9 | 13 |
| Green ash | 61.5 | 92 | 22.3 | 6 | 25.0 | 4 |
| Black walnut | 32.8 | 91 | 16.7 | 6 | 19.0 | 7 |
| Catalpa | 50.1 | 78 | 43.5 | 8 | 33.5 | 8 |
| Redcedar | 35.4 | 83 | 42.5 | 2 | 23.9 | 13 |
| Jack pine | 27.9 | 27 | 39.8 | 4 | 11.4 | 7 |
| Average all species | 45.8 | | 36.7 | | 21.4 | |
| Total | | 1071 | | 81 | | 118 |

TABLE 2.—AVERAGE SURVIVAL PERCENT FOR SEVERAL SPECIES AS AFFECTED BY PLANTING METHOD

| Species | Planting method | | | | | |
|---|---|---|---|---|---|---|
| | Good | | Fair | | Poor | |
| | Average survival | Plantings examined | Average survival | Plantings examined | Average survival | Plantings examined |
| | *Percent* | *Number* | *Percent* | *Number* | *Percent* | *Number* |
| Shortleaf pine | 41.1 | 149 | 42.5 | 89 | 37.7 | 12 |
| Black locust | 65.8 | 125 | 63.9 | 102 | 69.7 | 9 |
| Ponderosa pine | 23.6 | 81 | 26.6 | 36 | 21.7 | 6 |
| Osage orange | 45.1 | 58 | 37.5 | 50 | 31.3 | 3 |
| Green ash | 63.4 | 63 | 49.5 | 34 | 78.5 | 2 |
| Black walnut | 34.6 | 57 | 27.4 | 39 | 20.6 | 8 |
| Catalpa | 48.0 | 49 | 50.0 | 43 | 0.0 | 1 |
| Redcedar | 34.2 | 55 | 40.1 | 34 | 25.0 | 3 |
| Jack pine | 25.8 | 26 | 27.6 | 14 | 0.0 | 1 |
| Average all species | 43.6 | | 43.0 | | 37.3 | |
| Total | | 744 | | 470 | | 46 |

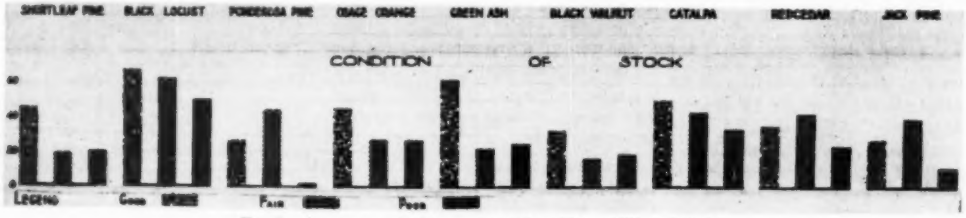


FIG. 1.—Average survival percent as affected by condition of stock.

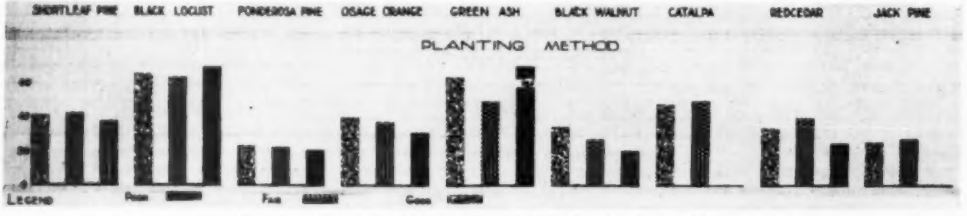


FIG. 2.—Average survival percent as affected by planting method.

cated for those plantings where neither protection nor control of competing vegetation was provided.

Of the four criteria of establishment treatment used in this study, plantation care was the one most readily determined in the field. By careful inspection of the plantation the information obtained from the planter could be checked. This was especially true of protection. The effect of plantation care upon survival is also the most consistent of the four criteria of establishment treatment, showing a reasonable trend in survival downward from good to poor plantation care for nearly all the major species planted.

*Variation of survival by species.*—In addition to the effects of establishment treatment upon survival, there also appears to be a difference in survival among species (Table 5). Black locust shows the highest survival of the major species. Green ash has nearly as high an average survival as black locust, and catalpa is a poor third. Black walnut and all the evergreens have low average survival. Ponderosa pine and jack pine, both of which seem low in survival in this study, are actually quite dissimilar in certain respects. Ponderosa pine is definitely a poor species to plant in most of Missouri, whereas jack pine may still prove to be acceptable for certain uses, such as windbreaks and Christmas trees in the northern part of the state. The low average survival of jack pine may be attributed to the fact that 20 out of a sample of 46 plantations had no survival because of poor establishment treatment. On the other hand, where jack pine has been planted well and cared for properly, it has been quite successful. Plantations of jack pine made by the forestry de-

TABLE 3.—AVERAGE SURVIVAL PERCENT FOR SEVERAL SPECIES AS AFFECTED BY CONDITION OF SITE

| Species | Condition of site | | | | | |
|---|---|---|---|---|---|---|
| | Good | | Fair | | Poor | |
| | Average survival | Plantings examined | Average survival | Plantings examined | Average survival | Plantings examined |
| | *Percent* | *Number* | *Percent* | *Number* | *Percent* | *Number* |
| Shortleaf pine | 42.8 | 93 | 42.5 | 49 | 38.1 | 112 |
| Black locust | 70.8 | 57 | 75.2 | 79 | 64.1 | 104 |
| Ponderosa pine | 26.4 | 62 | 22.9 | 19 | 21.1 | 45 |
| Osage orange | 59.6 | 30 | 44.4 | 29 | 43.1 | 41 |
| Green ash | 69.9 | 34 | 64.9 | 29 | 43.1 | 41 |
| Black walnut | 39.9 | 32 | 37.4 | 18 | 24.0 | 39 |
| Catalpa | 59.0 | 36 | 63.8 | 20 | 30.0 | 39 |
| Redcedar | 39.3 | 41 | 48.4 | 12 | 28.2 | 46 |
| Jack pine | 28.8 | 16 | 27.4 | 7 | 24.4 | 19 |
| Average for all species | 46.4 | | 51.7 | | 35.3 | |
| Total | | 447 | | 288 | | 565 |

TABLE 4.—AVERAGE SURVIVAL PERCENT FOR SEVERAL SPECIES AS AFFECTED BY PLANTATION CARE

| Species | Plantation care | | | | | |
|---|---|---|---|---|---|---|
| | Good | | Fair | | Poor | |
| | Average survival | Plantings examined | Average survival | Plantings examined | Average survival | Plantings examined |
| | *Percent* | *Number* | *Percent* | *Number* | *Percent* | *Number* |
| Shortleaf pine | 53.6 | 33 | 47.3 | 108 | 29.8 | 114 |
| Black locust | 72.8 | 23 | 74.3 | 105 | 55.4 | 114 |
| Ponderosa pine | 50.7 | 18 | 24.0 | 56 | 16.5 | 57 |
| Osage orange | 47.0 | 10 | 60.4 | 35 | 32.1 | 70 |
| Green ash | 85.5 | 11 | 58.9 | 53 | 50.0 | 45 |
| Black walnut | 98.3 | 12 | 41.1 | 38 | 21.9 | 54 |
| Catalpa | 67.6 | 9 | 53.0 | 48 | 38.9 | 41 |
| Redcedar | 58.4 | 12 | 34.8 | 37 | 27.8 | 49 |
| Jack pine | 40.0 | 2 | 39.6 | 19 | 12.8 | 21 |
| Average all species | 59.4 | | 49.5 | | 35.8 | |
| Total | | 139 | | 554 | | 615 |

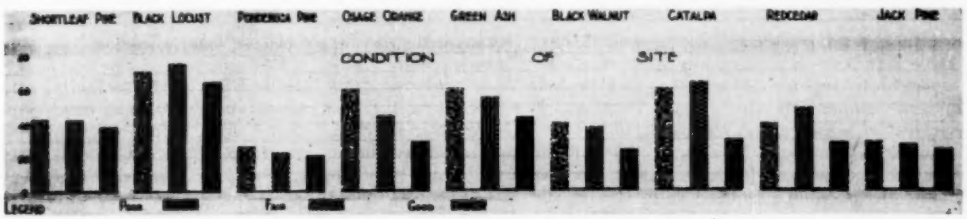


FIG. 3.—Average survival percent as affected by condition of site.

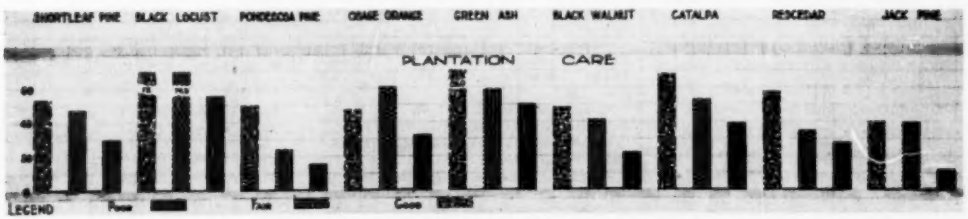


FIG. 4.—Average survival percent as affected by plantation care.

TABLE 5.—AVERAGE SURVIVAL PERCENT BY MAJOR SPECIES

| Species | Average survival | Number of plots |
|---|---|---|
| | *Percent* | |
| Black locust | 64.1 | 250 |
| Green ash | 57.3 | 120 |
| Catalpa | 47.6 | 106 |
| Osage orange | 41.8 | 121 |
| Shortleaf pine | 40.3 | 274 |
| Redcedar | 33.9 | 106 |
| Black walnut | 30.6 | 117 |
| Jack pine | 26.1 | 46 |
| Ponderosa pine | 25.2 | 143 |

TABLE 6.—AVERAGE SURVIVAL PERCENT OF MAJOR SPECIES AS AFFECTED BY ASPECT

| Species | Survival percent | |
|---|---|---|
| | Cool aspect | Warm aspect |
| Black locust | 67.0 | 62.0 |
| Green ash | 59.4 | 55.6 |
| Catalpa | 53.0 | 43.7 |
| Osage orange | 48.0 | 38.6 |
| Shortleaf pine | 43.5 | 37.4 |
| Jack pine | 40.8 | 19.7 |
| Redcedar | 38.6 | 32.0 |
| Black walnut | 31.2 | 27.6 |
| Ponderosa pine | 31.2 | 20.2 |

TABLE 7.—AVERAGE HEIGHT GROWTH OF MAJOR SPECIES IN 11-YEAR-OLD PLANTATIONS

| Species | Average height |
|---|---|
| | *Feet* |
| Black locust | 20.7 |
| Green ash | 15.1 |
| Catalpa | 13.4 |
| Shortleaf pine | 13.2 |
| Black walnut | 12.7 |
| Osage orange | 11.3 |
| Redcedar | 10.6 |
| Ponderosa pine | 9.8 |

partment of the University of Missouri near Columbia have a high average survival and a good rate of growth on a variety of soil conditions. Ponderosa pine planted in the same situations shows consistently lower survival and poorer rate of growth.

The low average survival of black walnut can be partly explained by the sensitivity of the species to establishment treatment and also by the fact that black walnut is a difficult species to transplant. Serious damage to the root systems of nursery stock is almost inevitable for this taproot ed species; consequently, plantations of black walnut frequently require more than one growing season to become adapted to the planting site and to start to grow well. Due to the slow start, the period of high susceptibility to influences which ordinarily cause mortality is extended, resulting in low survival of this highly desirable species.

*Effect of aspect.*—The data in Table 6 indicate a relationship of aspect to survival for all the major species. Apparently the average survival is higher on cool aspects than on warm aspects. Better survival on cool aspects is probably due to the prevailing climatic and soil conditions. Extreme continental climate and heavy soils usually underlain with claypan at shallow depths tend, in themselves, to create difficult situations for planted trees. The critical nature of extreme climate and heavy soils is accentuated on warm aspects where soil moisture and soil temperature are likely to fluctuate more critically than on cool aspects. This effect of aspect on survival is largely in agreement with the findings of Auten and Plair,[2] Hopp and Grober,[3] Limstrom and Merz,[4] and Minckler.[5]

*Effect of erosion at the time of planting.*—Survival is generally poorer on eroded than on non-eroded sites, but the differences are small except for two of the major species. Osage orange and catalpa show the most striking reduction in survival, and apparently should not be planted on eroded sites. The survival of shortleaf pine is apparently somewhat better on eroded than on non-eroded sites. This may be due to the ecological characteristics of the species or to differences in soil site factor which have not been taken into consideration in the designation of eroded and non-eroded sites. At any rate shortleaf pine, because of its apparent adaptability to eroded sites, is a better species to plant on such sites than are any of the hardwoods.

*Effect of grazing.*—Plantations which have been grazed generally have lower survival than those which have been protected from grazing. However, as in the case of the effect of erosion on survival, the differences have not been large. In the cases of non-palatable species, such as redcedar and black walnut, survival was apparently not reduced by grazing. The difficulty of obtaining an adequate measure of the effect of grazing from these data should not be overlooked. Much of the effect of poor plantation care is undoubtedly due to the effect of grazing, but the amount of reduction in survival attributable to grazing is not readily separable from reduction in survival brought about by other factors.

## Factors that Affected Height Growth

*Variation by species.*—A few factors which seemed to have some relationship to survival also seem to have an effect upon the growth of planted trees. Table 7 shows the height growth of major species in 11-year-old plantations. Black locust and green ash have made the most rapid height growth and ponderosa pine made the slowest growth. Slow growth combined with low survival should be sufficient evidence against the continued planting of ponderosa pine. In addition to these faults, ponderosa pine is almost always infected with a leaf disease which contributes materially to its early mortality. Nevertheless in a few isolated instances, ponderosa pine has been established successfully in the northern part of the state. Thus, despite its rather poor showing throughout most of the state, this species cannot yet be considered a complete failure.

The high survival and rapid growth of black locust, on the other hand, seem to indicate that this is the most successful of the species planted. Again, height growth and survival are not the only con-

[2]Auten, John T. and T. B. Plair. Forests and soils. Yearbook of Agric. 114-119. 1949.

[3]Hopp, Henry and Samuel Grober. Effect of site on growth of shipmast locust. Jour. Agric. Research 74: 315-328. 1947.

[4]Limstrom, G. A. and R. W. Merz. Rehabilitation of land stripped for coal in Ohio. Central States Forest Exp. Sta. Tech. Paper 113. 1949.

[5]Minckler, Leon S. Effect of rainfall and site factors on the growth and survival of young forest plantations. Jour. Forestry 41: 829-833. 1943.

siderations. Black locust plantations are almost always inhabited by the locust borer, and although the damage done by this insect does not always destroy the planting completely, frequently a large proportion of the stems are ruined. Because of borer damage, plantations of black locust are frequently regarded as a complete loss by their owners, even though this may not necessarily be the case.

*Effect of aspect.*— Average height of 11-year-old plantations of the major species on cool and warm aspects is presented in Table 8. With the exception of green ash, height growth seems to be somewhat greater on cool aspects than on warm aspects; however, the difference in the case of shortleaf pine is so small as to indicate that the growth of this species is not affected by aspect. The generally poorer performance of most species on warm aspects is especially true for most of the hardwoods. The height growth of black walnut, osage orange, catalpa, and black locust on warm aspects is more than 20 percent less than the growth of the same species on cool aspects. The height growth of redcedar on cool aspects is based upon too small a sample to make a valid comparison with its growth on warm aspects.

*Effect of erosion at time of planting.*—Rate of height growth for most species is apparently less on eroded sites than on non-eroded sites. Osage orange planted on eroded sites grew 38 percent slower in height than it did on non-eroded sites. Black locust grew 12 percent slower on eroded than on non-eroded sites and also had more serious infestations of locust borer on eroded than on non-eroded sites. Consequently, neither of these species, which have been widely planted for erosion control in the past, should be used for that purpose in the future. The height growth of shortleaf pine, on the other hand, was apparently not affected by erosion, so that this species should replace the other two where trees are planted for erosion control.

TABLE 8.—EFFECT OF ASPECT ON HEIGHT GROWTH OF MAJOR SPECIES IN 11-YEAR-OLD PLANTATIONS

| Species | Average heightin feet | |
|---|---|---|
| | Cool aspect | Warm aspect |
| Black locust | 24.8 | 18.8 |
| Catalpa | 15.6 | 11.5 |
| Redcedar (low basis) | 15.0 | 8.5 |
| Green ash | 14.3 | 16.5 |
| Black walnut | 14.1 | 11.0 |
| Shortleaf pine | 13.2 | 13.1 |
| Osage orange | 12.7 | 9.6 |
| Ponderosa pine | 10.2 | 9.2 |

*Effect of grazing.*—A reduction of height growth for six of the major species accompained grazing of the plantations. The reduction in height growth caused by grazing ranged from 10 percent for green ash to 28 percent for osage orange. The average height growth of black walnut and redcedar was apparently more rapid on grazed than on ungrazed plantations. Perhaps the relative unpalatability and the intolerance of these two species partially explains this seemingly reversed relationship. Both black walnut and redcedar are common pasture trees.

## Summary

Apparently survival of forest plantations in Missouri is affected most critically by the influence of the man-controlled factors involved in establishment treatment. Undoubtedly climatic considerations and soil factors also have an important bearing upon survival, as indicated by the effects of erosion and aspect. In the main, however, survival is dependent upon condition of site at the time of planting, the planting method used to establish the plantation, condition of stock at the time of planting, and plantation care. If the planting program is to be more successful in the future than it has been in the past, a higher level of practice must be attained in each of the categories of establishment treatment.

Growth of forest plantations in Missouri is dependent to some extent upon species, aspect, erosion condition at time of planting, and grazing; however, the most important factors affecting growth (in contrast to survival) are probably those which affect the excellence of planting sites. It is hoped that a measure of the quality of planting sites will be obtained from the analysis of the soil and climatic data which have been collected. Nevertheless, until planting practice is capable of producing higher survival, the importance of growth of forest plantations is secondary.

# Effect of Soil Fertility on the Physical and Chemical Properties of Tree Seed[1]

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THE IMPORTANCE of seed origin has been recognized since the middle of the eighteenth century. Much of the early information was obtained, not as the result of planned experiments, but from observations of forest plantations established from seed of different provenance.

The European investigations were concerned largely with *Pinus silvestris* and *Picea excelsa* (*3, 10*). As seed of various origin was used for establishing plantations, different strains or varieties of these two species were recognized.

Studies patterned after the European provenance experiments were carried on by American foresters with *Pseudotsuga taxifolia*, *Pinus ponderosa*, and *Pinus resinosa* (*1, 11, 12, 13*). Extensive planting of *Pinus silvestris* in this country has also sharply manifested the significance of seed origin on the form and growth potential of this species.

Both the European and American studies dealt primarily with the growth characteristics of different geographical strains induced largely by climatic factors. These studies were concerned mainly with the regional origin of seed, rather than with the individual characteristics of the parent trees or parent stands.

Many writers have suggested that the nature of the soil has an effect on the quality and quantity of seed produced by forest trees, but no concrete evidence verifying such an assumption has thus far been offered. The aim of this study was to ascertain the effect of soil fertility on the composition of seed.

## Investigations of the Properties of Seed of Different Origin

Seed of Norway spruce and red pine was collected from stands located on a wide range of Wisconsin soils. Seed collections were confined to small areas and few trees, in order to insure maximum uniformity of seed material and soil conditions. Seed of Norway spruce was collected from artificially established plantations or purchased from different parts of Europe. Three plantations served as sources of red pine seed; the remainder of seed was gathered from native stands.

Representative samples of the surface 7 inches of soil were taken at each seed collection site. The soil was air dried, sieved, and analyzed for pH, total nitrogen, available phosphorus and potassium, exchangeable calcium and magnesium, and cation exchange capacity by the standard methods of the University of Wisconsin Soils Department (*15*).

Prior to analysis the seed was placed in 95 percent ethyl alcohol to remove the empty seed. Then moisture content and dry weight were determined in triplicate. Germination tests were made in sand flats in the greenhouse. The determinations of phosphorus, potassium, and magnesium contents in seed were made by a perchloric acid wet digestion method (*9*). Total nitrogen and organo-solubles were determined by Association of Official Agricultural Chemists procedures (*1*).

## Results and Discussion

*Norway spruce.*—The results of analyses of soils supporting local Norway spruce plantations are summarized in Table 1. Information on the composition of soil of the European sources was limited to climatic-zonal characteristics of soil profiles.

The results of analyses presented in Table 2 reveal several relationships. The germinative capacity of seed showed a close correlation with seed weight. The nearly barren sandy soil of Waushara County produced seed of light weight and

TABLE 1.—STATE OF SOIL FERTILITY FACTORS IN 7 INCH SURFACE LAYER OF SOILS SUPPORTING NORWAY SPRUCE PLANTATIONS USED AS SEED SOURCES

| Seed source, age of plantation, and year of collection | Reaction | Exch. cap. | Total N | Avail. $P_2O_5$ | Avail. $K_2O$ | Exch. Ca | Exch. Mg |
|---|---|---|---|---|---|---|---|
| | *pH* | *ME per 100g* | *Percent* | *Lbs. per acre* | | *ME per 100g* | |
| Coarse siliceous outwash sand; 40 years; Waushara County | 4.70 | 4.50 | .070 | Trace | 80 | .88 | .33 |
| Nut-structured silt loam; 70 years; Vernon County | 6.80 | 15.40 | .171 | 120 | 408 | 11.10 | 1.60 |
| Podzolic sandy loam; 34 years; Vilas County | 4.69 | 8.56 | .088 | 75 | 304 | 1.91 | .36 |
| Calcareous sandy loam; 35 years; Door County | 7.05 | 14.90 | .165 | 32 | 154 | 13.44 | 4.01 |

TABLE 2.—DRY WEIGHT, MOISTURE CONTENT, AND GERMINATIVE CAPACITY OF NORWAY SPRUCE SEED OF DIFFERENT ORIGIN

| Seed source and year of collection | Dry weight per M of seed | Moisture content | Germinative capacity |
|---|---|---|---|
| | *Grams* | *Percent* | *Percent* |
| Coarse siliceous outwash sand, Waushara Co., 1947 | 2.45 | 6.58 | 21 |
| Podzolic sandy loam, Vilas Co., 1947 | 5.09 | 5.86 | 55 |
| Podzolic sandy loam, Vilas Co., 1948 | 10.09 | 5.96 | 67 |
| Calcareous sandy loam, Door Co., 1948 | 10.62 | 6.49 | 65 |
| Nut structured silt loam, Vernon Co., 1947 | 4.99 | 5.78 | 62 |
| Sweden, 1947 | 5.11 | 5.24 | 54 |
| Austria, 1947 | 6.55 | 5.32 | 64 |

[1]This paper includes portions of a thesis submitted in partial fulfillment of the requirements for the Ph.D. degree, University of Wisconsin. The author is indebted to Prof. S. A. Wilde, under whose direction this study was conducted, and to Messrs. William Brener and Robert Dosen for their help in different phases of the study. Financial aid was provided through funds granted by the Wisconsin Conservation Department.

TABLE 3.—COMPOSITION OF NORWAY SPRUCE SEED OF DIFFERENT ORIGIN EXPRESSED IN PERCENT AND MILLIGRAMS PER SEED

| Seed source and year of collection | Total N | | $P_2O_5$ | | K O | | MgO | | Ether solubles | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* |
| Coarse siliceous outwash sand, Waushara Co., 1947 | 1.58 | .039 | 1.60 | .039 | .64 | .016 | .55 | .014 | 41.60 | 1.02 |
| Nut structured silt loam, Vernon Co., 1947 | 2.25 | .112 | 2.11 | .105 | .82 | .041 | .78 | .039 | 45.21 | 2.26 |
| Podzolic sandy loam, Vilas Co., 1947 | 3.17 | .161 | 1.99 | .101 | .94 | .047 | .66 | .034 | 39.48 | 2.02 |
| Podzolic sandy loam, Vilas Co., 1948 | 3.10 | .312 | 1.83 | .185 | .88 | .089 | .66 | .067 | 37.83 | 3.82 |
| Calcareous sandy loan, Door Co., 1948 | 3.39 | .360 | 1.97 | .209 | .94 | .100 | .78 | .083 | 39.30 | 4.17 |
| Sweden, 1947 | 3.21 | .164 | 1.85 | .095 | .96 | .049 | .65 | .033 | 39.41 | 2.02 |
| Austria, 1947 | 3.22 | .212 | 1.78 | .117 | .92 | .061 | .78 | .051 | 38.03 | 2.49 |
| L.S.D. (.05)[1] | ... | .011 | ... | .016 | ... | .009 | ... | .004 | ... | .14 |
| L.S.D. (.01)[1] | ... | .018 | ... | .025 | ... | .014 | ... | .006 | ... | .22 |

[1]Analyses of variance made only for 1947 collection.

a particularly low germinative capacity. It should be stressed however, that seed collected from the same stands in different years showed a great variation in its average weight: The seed collected in 1948 is twice as heavy, on the average, as that collected in 1947. These observations suggest that valid comparisons of seed quality cannot be made without regard for annual variations. The variation in seed composition expressed on a percentage basis is obscured by differences in the weight of seed (Table 3). The only exception is seed produced on nearly barren sandy soil of Waushara County. The supply of nutrient elements and ether solubles calculated per seed, however, showed marked differences in the composition of seed of different provenance. This is particularly true in regard to seed from Waushara County.

*Red pine.*—The state of fertility factors in soils supporting parent trees of red pine are presented in Table 4. The results of seed analyses assembled in Tables 5 and 6 show that the seed of the highest germination capacity and content of reserve nutrients (1947 collection) was produced on infertile soils: namely, strongly acid, gley-podzolic sand in Juneau County and wind-blown sand in Adams County. A re-examination of the soil profiles to a depth of several feet revealed the presence of conditions that might account for this seemingly paradoxical relationship. The gley-podzolic sand in question was underlain at a depth of five feet by a ground water table that apparently acted as a dilute liquid fertilizer (*16, 17*). On the other hand, excavation of wind-blown sand revealed a buried humus layer at an approximate depth of 2½ feet. The concealed humus undoubtedly furnished some nutrients to the roots of parent trees.

TABLE 4.—STATE OF SOIL FERTILITY FACTORS IN 7-INCH SURFACE LAYER OF SOILS FROM DIFFERENT RED PINE SEED SOURCES

| Seed source, age of stand, and year of collection | Reaction | Exch. cap. | Total N | Avail. $P_2O_5$ | Avail. $K_2O$ | Exch. Ca | Exch. Mg |
|---|---|---|---|---|---|---|---|
| Gley-podzolic sand; 48 years; | | *ME per* | | | | | |
| | *pH* | *100g* | *Percent* | *Lbs. per acre* | | *ME per 100g* | |
| Juneau Co.; 1947 | 3.78 | 6.71 | .070 | 23 | 86 | .50 | .22 |
| Coarse siliceous outwash sand; 20 years;[1] Waushara Co.; 1947 | 5.58 | 3.92 | .050 | 40 | 80 | 1.31 | .31 |
| Wind-blown sand; 21 years;[1] Adams Co.; 1947 | 4.76 | 3.60 | .037 | Traces | 24 | .53 | .18 |
| Calcareous sandy loam; 22 years;[1] Door Co.; 1947 | 7.18 | 18.10 | .198 | 35 | 125 | 20.54 | 5.21 |
| Melanized sand; 61 years; Marinette Co.; 1947 | 5.06 | 8.48 | .105 | 46 | 130 | 3.41 | .78 |
| Wind-blown sand; 53 years; Washburn Co.; 1948 | 4.59 | 3.54 | .043 | 25 | 32 | .51 | .21 |
| Podzolic sandy loam; 48 years; Washburn Co.; 1948 | 4.71 | 8.72 | .100 | 58 | 182 | 3.14 | .26 |
| Podzolic sandy loam; 32 years; Oneida Co.; 1948 | 4.52 | 9.75 | .069 | 69 | 108 | 2.37 | .52 |
| Podzolic sandy loam; 28 years; Oneida Co.; 1948 | 4.72 | 11.62 | .090 | 82 | 173 | 2.24 | .52 |

[1]Plantations.

TABLE 5.—DRY WEIGHT, MOISTURE CONTENT, AND GERMINATIVE CAPACITY OF RED PINE SEED OF DIFFERENT ORIGIN

| Seed source and year of collection | Dry weight per M of seed | Moisture content | Germinative capacity |
|---|---|---|---|
| | *Grams* | *Percent* | *Percent* |
| Gley-podzolic sand, Juneau Co., 1947 | 11.78 | 5.56 | 97 |
| Coarse siliceous outwash sand, Waushara Co., 1947 | 10.87 | 5.24 | 85 |
| Wind-blown sand, Adams Co., 1947 | 11.31 | 5.29 | 89 |
| Calcareous sandy loam, Door Co., 1947 | 10.32 | 5.11 | 89 |
| Melanized sand, Marinette Co., 1947 | 10.17 | 3.71 | 83 |
| Wind-blown sand, Washburn Co., 1948 | 8.22 | 5.73 | 80 |
| Podzolic sandy loam, Washburn Co., 1948 | 8.88 | 4.90 | 92 |
| Podzolic sandy loam, Oneida Co., 1948 | 8.76 | 4.08 | 86 |
| Podzolic sandy loam, Oneida Co., 1948 | 9.04 | 4.21 | 88 |

The physical and chemical properties of the seed collected in 1948 appear to be correlated with the state of soil fertility. None of these soils was influenced by the ground water table or had any uncommon profile features.

The seed produced on the wind-blown sand in Washburn County was lighter, had a lower germinative capacity, and had a lower content of reserve nutrients than the seed originating from stands on podzolic sandy loam soils (Table 7).

The results of studies with both Norway spruce and red pine indicate that seed produced on infertile soils is generally of poor quality. Other investigations have shown

TABLE 6.—COMPOSITION OF RED PINE SEED OF DIFFERENT ORIGIN EXPRESSED IN PERCENT AND MILLIGRAMS PER SEED (1947 COLLECTION)

| Seed source | Total N | | $P_2O_5$ | | $K_2O$ | | MgO | | Ether solubles | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* |
| Gley podzolic sand, Juneau County | 5.23 | .616 | 2.09 | .246 | .86 | .101 | .65 | .077 | 28.90 | 3.40 |
| Coarse siliceous outwash sand, Waushara County | 5.06 | .550 | 2.23 | .242 | .95 | .103 | .63 | .068 | 30.57 | 3.32 |
| Wind-blown sand, Adams County | 5.01 | .556 | 2.25 | .253 | .91 | .103 | .63 | .071 | 29.70 | 3.36 |
| Calcareous sandy loam, Door County | 4.96 | .513 | 2.11 | .218 | .89 | .092 | .66 | .068 | 28.94 | 2.90 |
| Melanized sand, Marinette County | 4.96 | .505 | 2.04 | .208 | .90 | .092 | .66 | .067 | 29.25 | 2.97 |
| L.S.D. (.05) | | .020 | | .006 | | N.S. | | N.S. | | .13 |
| L.S.D. (.01) | | .031 | | .010 | | | | | | .20 |

TABLE 7.—COMPOSITION OF RED PINE SEED OF DIFFERENT ORIGIN EXPRESSED IN PERCENT AND MILLIGRAMS PER SEED (1948 COLLECTION)

| Seed source | Total N | | $P_2O_5$ | | $K_2O$ | | MgO | | Ether solubles | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* | *Pct.* | *Mg.* |
| Wind-blown sand, Washburn County | 4.63 | .380 | 1.88 | .154 | .78 | .064 | .63 | .052 | 29.33 | 2.41 |
| Podzolic sandy loam, Washburn County | 4.79 | .425 | 2.14 | .190 | .88 | .078 | .68 | .060 | 29.84 | 2.66 |
| Podzolic sandy loam, Oneida County | 4.76 | .416 | 2.02 | .177 | .89 | .078 | .66 | .058 | 29.81 | 2.61 |
| Podzolic sandy loam, Oneida County | 4.96 | .448 | 2.09 | .189 | .83 | .075 | .66 | .060 | 28.33 | 2.56 |

that poor quality may also be reflected in the inherent vigor of the seedlings produced from such seed (*18, 19*). In several instances, when fertilizers have been applied to correct nutrient deficiencies in soils, the quality of seed produced has been improved significantly as compared to that produced on unfertilized plots (*5, 6*).

In view of these facts, it would be advisable to avoid infertile soils when choosing sites for the establishment of seed "orchards" or plantations. The advice of a competent forest soils technician, in such cases, can play an important role in assuring a source of high quality seed.

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# Using Aircraft in Checking Forest Photo-Interpretation

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*If timber inventories are to be based on forest stand maps compiled from aerial photographs, it becomes necessary to check and verify the identification of forest types on the photographs before the type or stand maps are constructed. Failure to make such a check may lead to serious errors in the acreage summary and subsequently in the volume and growth estimates.*

FAULTY PHOTO-INTERPRETATION is a possibility encountered whenever aerial photographs are used in forestry. The verification of the photo-interpretation is a problem on small areas, but it become particularly troublesome on large areas because of the sheer magnitude of the job. On large scale operations, as in the case of management cruise of a 100,000 acres or more, or an inventory of the potential timber within a given radius of a mill, spot checking or sampling for errors may be employed for correcting the cruise. However, the resulting type map could never be trusted until checked in the field.

There are two main factors that lead to errors in photo-interpretation. The first of these is the setting up of job specifications that demand the separation of timber types that do not lend themselves to ready identification. In some cases large investments in engineering developments may depend on the photo-interpreter's opinion of the composition of certain inaccessible stands. Errors in identification of such stands are very embarrassing to the photo-interpreter and expensive to the company depending on his work. It is obvious that all such stands should be investigated on the ground before engineering work is begun.

The second factor affecting the accuracy of a type map made from aerial photographs is the age of the photographs. Land use in many areas is dynamic and in a constant state of change. Timber stands are cut; agricultural land is abandoned; destruction or serious damage is caused by fire, insects, and disease; stands grow in height and density; and many other features of the land-use picture are changed constantly. The amount of change, rather than time alone, determines whether or not the photographs are out of date and the amount of checking that must be done. As an example, the author has seen the case where photographs of a Maine township were scarcely one month old and yet were largely out of date as a result of heavy pulpwood cuttings that virtually eliminated the accessible merchantable stands. On the other hand, however, there are virgin areas in the mountains and in the deep coastal swamps where photographs 10 or 20 years of age would still have value for construction of forest stand maps.

Since greater stress is being placed on aerial photographs in modern forest inventory, it is believed that the problem of verifying photo-interpretation is one that merits serious consideration. Presented here is how one organization set up its work and developed procedures to keep such errors at a minimum.

## History

Checking forest photo-interpretation is normally a comparatively simple operation involving little more than riding all the roads in the area and checking the stands along the way. In such cases, it is not an arduous job and is merely time consuming and not too expensive. However, on large-scale operations and operations in difficult or roadless terrain, the problem assumes much more formidable proportions.

In an attempt to overcome these difficulties while making a stand map of some 50,000 acres in the Dismal Swamp in Virginia, C. T. Brown, Jr., then of the Harvard Forest and later with the Sable Mountain Corporation of Rutland, Vt., flew over the area with delineated (interpreted and annotated) photographs in hand and checked the interpretation, stand by stand. This operation was a success and led the way to further development of the technique. On later jobs, ranging from 3,000 acres to 1,600 square miles, the technique was developed by Brown and the author into a dependable procedure. Work was done in Virginia, North Carolina, Florida, Vermont, Maine, and Ontario, using the aerial check with consistently good results *where the necessary identification could be made from the air.*

Identification of species is the main problem in aerial checking. It is, for instance, manifestly impossible to make needle counts on southern pines while in an airplane. It is impossible in many cases, therefore, positively to identify a given species. Broad species groups should be used so as to make identification as easy as possible. During certain seasons, however, and under certain conditions, it is possible to do a startlingly good job of identification from a low-flying plane. A case in point is the differentiation of slash pine from longleaf pine in northeastern Florida. In July the candles of new growth on the slash pine are distinctive enough to prove of diagnostic value. It is also possible to separate red and black spruce from balsam fir in northern Maine and in Canada by the shape and branching habit of the apex of the tree. In contrast, it is virtually impossible to separate loblolly pine and pond pine in the coastal swamps of North Carolina.

## Procedure

The forest photo-interpretation procedure that was finally evolved is as follows:

*1. Familiarization with local con-*

*ditions.* — The photo-interpreters are first sent into the area to become familiar with the local timber types and conditions. They tour the area in automobles or boats and compare ground conditions with photo appearance, taking notes and annotating the photographs so that a photo-interpretation key can be developed. In many cases a formal key is not constructed, but the notes are organized so as to be effective in helping the interpreters as the work progresses.

*2. Small scale test.* — After the familiarization is completed, each man is assigned a small area with more or less typical conditions. This area is then completely interpreted using the information from the photo-interpretation keys, and heights and densities measured in the standard manner. The interpretation is done in the same manner as determined by the specifications for the over-all job.

When the interpretation is completed, a thorough ground check is made of the practice area. All mistakes are recorded and changes made in the keys wherever necessary. Errors in height computations also show up, and the computations, therefore, can be verified. The possibility of computation error is relatively greater in shadow-height ratios than with parallax methods, but once the ratios are confirmed the shadow method is often preferred because of the more positive measurements that can be made when conditions are favorable. This check of the practice area provides the interpreters with enough guides to prevent major errors later.

*3. Photo-interpretation of the remaining area.* — The main job of photo-interpretation is then begun and continued until completed. If the job is large enough to keep the interpreters busy for a month or more, they are sent back into the area at approximately two-week intervals in order to remain familiar with the ground conditions. Such visits are usually combined with the checking phase of the operation.

*4. Checking the photo-interpretation.* — Upon completion of the photo-interpretation or at two- to three-week intervals, the interpreters are sent aloft in a low-flying light aircraft to check for interpretation errors and for land-use changes that might have occurred since the photographs were taken. Gross errors in heights and densities are corrected, but normally better estimates of height and density can be made from the photographs than from the plane. Corrections are made on the annotated photographs with a different color china-marking pencil than those used in the original delineation.

The planes are flown at altitudes ranging from 50 to 400 feet above the trees. A flying altitude of 200 to 300 feet is usually necessary to prevent becoming lost, but occasionally it is necessary to dip lower in order to make the identification certain. Normally the plane works its way up to a flight strip in a continuing "S" pattern, flying into the wind as much as possible to reduce ground speed. The plane is trimmed to fly as slowly as possible, which places it more or less in a continual power stall. With the type of aircraft being used, this type of flying is not considered very hazardous.

Best results are obtained if the flying is done in the early morning before the air becomes turbulent or on gray, overcast days, when the air is relatively still. At altitudes as low as described, turbulence can be severe. The plane windows should provide for entry of fresh air, since the combination of turbulence and stuffy air can quickly reduce the efficiency of the checker to zero, because of air sickness. Such physical distress can attack even an experienced airman, such as a pilot, when he has to concentrate alternately on the photo-image and on the ground. Efficiency drops off rapidly after about two hours in the air. After a two-hour flight, the interpreter should rest at least two hours.

The rate of flight checking has averaged about 20 miles of flight strip per hour with the photographs at a scale of 4 inches to the mile.

### Types of Aircraft

Two types of aircraft may be considered. The first, and the one most commonly used, is a light two-seated plane of the Piper J-3 or Aeronca "Champion" model. These planes are very slow and are surprisingly stable and safe. Their stalling speed is very low and if stalled out they can recover quickly. Furthermore, they can make emergency landings in almost any kind of an opening. These planes are also desirable because of the tandem seating arrangement which makes it possible for the checker to see out of both sides of the plane without difficulty. Enclosed cabins are desirable and heating facilities are necessary in the winter. The removal of a door in the summer is often of great help. Such planes can be chartered at rates from $7 to $12 an hour. A pilot would add from $2 to $3 an hour. At these rates all operational expenses of the plane would be borne by the airport operator. If the job is large, it is often possible to get even lower rates by contracting to fly for a given number of hours.

The second type of aircraft that might be used for this work is the helicopter, but here cost is the major problem. Normally it is necessary to charter the helicopter at a rather distant base and the charge to get it onto the job is approximately $1 a mile. There is then a rather high per hour standby charge and an even higher per hour charge for the time in the air. In 1950 the cost on an average job was estimated to run around $600 per day. Since then the costs may have dropped. Because of the high costs, the use of the helicopter is justified only in cases where the absolute identification of highly inaccessible stands is necessary. In the case of remote stands in the coastal swamps where it is necessary to build railroads to bring out the timber, the added cost of being absolutely certain that the stands are what they appear to be is justified by the possi-

bility of great loss in engineering developments. In such cases a helicopter would be invaluable. A ground cruiser might take weeks or months to do as thorough a job as can be done in a helicopter in one day. In such inaccessible country, it might be possible to so arrange the operation that inaccessible stands can be cruised while being checked by setting down crews at the edges of the stands or in openings.

### C.A.A. Regulations

The Civil Aeronautics Board and the Civil Aeronautics Administration set up the rules and regulations for flying aircraft within the United States. Section 60.107 of the Air Traffic Rules, Civil Air Regulations, is devoted to minimum altitudes that must be maintained under various conditions. Part (c) of this regulation describes the rule for other than congested areas: "An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In such event, the aircraft shall not be operated closer than 500 feet to any person, vessel, vehicle, or structure. Helicopters may be flown at less than the minimums prescribed herein if such operations are conducted without hazard to persons or property on the surface and in accordance with (a) above." The preceding statement apparently limits flying to 500 feet but in a communication to the author, the C.A.A. states: "Specific operations, which cannot be conducted within the provisions of the Regulations in this Part, which would include many types of industrial and agricultural flying, require, prior to commencement of operation a certificate of waiver which may be obtained from the nearest office of the Civil Aeronautics Administration. When such certificates of waiver are issued, specific provisions are listed on the waiver which must be complied with by the operator." This indicates that there would be no objections to flight-checking forest photo-interpretation provided a certificate of waiver is obtained.

### Conclusions

1. It is often necessary to check forest photo-interpretation if accurate acreages, volumes, and growth are based on photo information.

2. Such checking can be done quickly and efficiently from a low flying airplane, particularly on large or inaccessible areas.

## A Pioneer Work in the Literature of Forest Genetics

Although few readers of the JOURNAL may be able to read Japanese, it seems worthwhile to place on record the first formal text on forest tree breeding to be published.[1] This book records the pioneering work in hybridization and induction of mutations by Dr. Sato, professor of silviculture and forest genetics at Kyushu University, Fukuoka, Japan. Twenty years' work by Dr. Sato and his collaborators form the background with which the author undertook the present work, which covers the whole literature of forest tree breeding and genetics more comprehensively than any publication the reviewers have seen.

The first volume lays the theoretical foundation for tree breeding. It starts with a chapter which points up the features in which breeding of forest trees differs from breeding of agricultural and garden plants. The remaining chapters of this volume deal with reproduction, variation, heredity, cytology, and the concept of race. As far as possible, woody plants are used to illustrate the principles discussed. The chapter on cytology includes what is perhaps the most comprehensive list of chromosome numbers of woody plants and arborescent monocots so far published. This list is quite usable by those who do not read Japanese, and provides a convenient guide to the literature on forest tree cytology.

The second volume deals with three practical problems with a chapter devoted to each. First is the problem of the characterization and identification of forest tree races. Methods of study are grouped under two main categories: static diagnosis, including morphological, anatomical, cytological, biochemical, physiological, and parasitological studies and experimental diagnosis including provenience plantation tests, progeny tests, and experimental breeding. An interesting feature of this chapter is the detailed account of sero-diagnosis applied to woody plants. There follows a chapter on the genetic and administrative aspects of forest seed procurement. The final chapter deals with the whole field of breeding in the broad sense. Included are thorough discussions of selection, hybridization, and the techniques for inducing mutations and chromosome alterations. Related matters such as seed production and methods of influencing it are also covered in detail. The author's work on induction of mutations in woody plants by fast neutron radiation is included.

The minor inconvenience of footnote literature citation is mitigated by ample author, plant, and subject indices.

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# New Trends in Standards of Range Use[1]

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*The mountain lands of the West yield the products essential to the region's welfare; namely, water, timber, and range for livestock and game. In addition these lands have high recreational and aesthetic value. In the West, water is precious above all things. The amount of available and usable water markedly influences urban as well as rural development and economy. The problem of improving and maintaining range land productivity is closely related to the problem of conserving water and making most effective use of it. It is for this reason that the subject of standards of range use is important, not only from a range-resource viewpoint but from other land uses as well.*

DURING THE PAST 50 YEARS we have witnessed the gradual development of a new science—the science of ecology. Among American leaders in this field were Cowles, Clements, Shantz, Weaver, Sampson, Nichols, and Hanson. Application of this new knowledge means that for the first time in history land use can be placed on a sound natural basis. We have yet much to learn about the application of ecological principles to land management. Along these lines a major contribution was Sampson's (*15*) work in 1919 in Utah on plant succession in relation to grazing use. He employed fundamental ecological findings as a basis for pointing out management objectives. Sampson recognized four broad stages in succession which for this range type correspond closely to our present day concept of range-condition classes of good, fair, poor, and very poor. A further step forward in making ecology understandable and useful to range administrators was Talbot's work in the Southwest (*17*) on plant, animal, and soil indicators of range condition.

In 1936 the western-wide utilization-standards project was initiated in the Divisions of Range Research and Range Management of the Forest Service with R. S. Campbell (*1*) in charge. The work led directly to the development of practical aids and guides in measuring grazing use and in setting up tentative utilization standards for mountain-range-lands. It also gave great impetus to the development of specific standards presented within regional in-service handbooks for appraising range condition on national-forest and adjacent range lands. In addition several publications resulted such as Pickford and Reid's (*12, 14*) work on the subalpine and mountain-meadow ranges of the Northwest; and Costello and Turner's (*3*) standards for shortgrass ranges of the Central Great Plains. Several of the state agricultural experimental stations and the Soil Conservation Service have published similar worth-while work such as that of Darrow (*4*) and Renner and Johnson (*13*). These agencies have been instrumental in obtaining application of this information by the private range owner. Findings have also been readily put into practice by other agencies such as the Production and Marketing Administration, the Indian Service, and the Bureau of Land Management.

Although utilization, condition, and range trend are closely interwoven and interdependent, it seems best for the purposes of clarity to treat them separately.

## Utilization Standards

Utilization is the degree to which vegetation has been removed by grazing, either from an individual plant, a single species, or the range as a whole. Utilization has an immediate and direct bearing on trend in range condition and ultimately on condition itself. Utilization standards attempt to set up, on the basis of research and experience, the degree of grazing use a range will stand without deterioration. "Proper-use factors" have been set up for most of our important western forage species. Many of these are still tentative and will no doubt be later modified in the light of future research findings and experience.

It is true that we may never know precisely what the "proper-use factor" for each and every forage species as related to site should be. It is also true that grazing animals don't graze in accordance with a standard. On a given area some specimens of the same forage species will be severely overcropped whereas others will be entirely unused. In spite of this, the concept of proper use will in most instances have to be borne in mind by the range administrator if our ranges are to be properly maintained and improved. As a management objective, he may have to resort to a weighted proper-use factor for the plant type and this will have to be varied as to soil and forage condition. For example, granitic and schist soils are generally highly erosive and accordingly have to be more carefully managed than more stable soils such as those derived from basalt. We know also that deteriorated ranges have to be more lightly grazed than ranges in good condition if we expect to restore them to maximum productivity within a reasonable length of time. This does not mean that we need a separate set of standards to meet every situation. For most situations two proper-use factors would suffice—one for use on ranges in good condition with stable soils, the other for use in situations where the erosion hazard is high or the forage condition unsatisfactory. This will require careful analysis of each range unit as to its principal indicator species and as to its present condition of vegetation and soil prior to the selection and application of utilization standards.

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Then too, in the past we have been prone to confine the utilization record to one or two key species when information should have been obtained on additional species. Although these perchance may have been minor in the composition, they often have high value as indicators of condition and trend. Lack of a more complete utilization record has often prevented early recognition of impending changes in the vegetation.

In the future our management, if it is to provide adequately for watershed, timber, and other needs, will in many instances have to be more intensive than it has been in the past. Range usable for livestock will have to be more carefully separated from that which is not usable (*8*). For example, on cattle ranges we will have to consider impractical full use of areas more than 1 to 2 miles from water, areas with steep, highly erodible soils, areas with dense timber, and areas greater than ½ mile from the slope bottom where the gradient is steeper than 40 percent. Areas in very poor condition will in some cases have to be reseeded in order to realize in full the capacity of the site for forage production. Game use, especially that of elk, will also have to be more carefully considered. Ultimately, in many areas we are going to have to decide just how much forage will be allocated to game and how much should be reserved for livestock use. Recognition of these various factors, in many instances, will require subdivision of the range into smaller units for management purposes. On the whole, through smaller units we can expect better management, including rotation and deferred grazing, which will increase forage and livestock production. In other words, land-use planning on the ecologic basis envisioned by Shantz (*16*), wherein each land use is in proper balance with other uses. An integral part of effective range planning is the use of sound range-condition standards.

### Range-Condition Standards

Range condition is generally defined as "range health." It is the relative position of a range with respect to its potential as determined by climate and soil under long-time proper grazing use. In other words, it is the state of present productivity of both forage and soil as classified in terms of what the range can and will support under the prevailing climate and soil and as related to and modified by range management objectives. Condition classes are commonly designated as excellent, good, fair, poor, and very poor. Excellent is ideal, with good satisfactory, and the remaining classes unsatisfactory. Criteria for describing each of these condition classes are generally based on the amount of plant cover, floristic composition, vigor, litter, and soil characteristics, especially with respect to erosion. In general the better condition classes have higher infiltration rates and lower erosion indices than the poor condition classes. In this respect objectives are similar to those of watershed management. Forage production is greatest generally in the higher condition classes because desirable forage species are abundant, they are in top vigor, and soil-moisture conditions are more favorable for growth. Change in either direction is influenced most by grazing treatment. The management objective is thus either upward from the bottom of the scale or, if at the top, to maintain it in this condition.

It is thus important that range-condition standards be on a firm ecological basis following closely the plant successional stages that can be expected to take place under grazing use.

There have been several schools of thought (*5, 7, 9, 11*) in the development of condition standards and their application in land management.

1. One school holds that the condition classes should be primarily and somewhat arbitrarily based on forage production; i.e., excellent = 90 to 100 percent of all forage it is possible to produce on the site; good = 75 to 90 percent and so on down to very poor in which less than 25 percent production occurs. Although in grassland vegetation forage production generally decreases with range deterioration this is not necessarily true in all plant communities. For example, open ponderosa pine may gradually close in, with reproduction crowding out or decreasing accessibility of forage. Lowered production is the result, and although the area may not have as high value for range it may still be considered as in satisfactory condition from the range aspect as well as from the watershed and timber condition. Furthermore, a scale based on forage production alone is purely artificial and largely ignores what can and will take place under grazing use. Admittedly we do not know with certainty all the specific details of all stages of succession as induced by grazing treatment for every plant community, but we do and are able to recognize the broad stages in the more important ones. Condition standards, to be sound and in accordance with what may occur with grazing use, should be developed from present knowledge of the life history of the key indicator species and of grazing stages of succession with later modifications if necessary, and filling in of details as our knowledge of the range type increases.

2. The development of condition standards for delineating condition classes has varied from a local to a subregional or regional basis. Standards have frequently been developed on a restricted local basis; with the thought in mind that criteria so obtained are more directly applicable. There is considerable danger in this, unless all stages of secondary succession may be found within the area.

For example, the local area may be in uniformly unsatisfactory condition and so be largely lacking in criteria which represent acceptable condition. Another reason advanced for locally developed standards is to make them conform with soils having a common origin and similar characteristics; in other words, a soil type. Since there may be a hundred or more soil types within a single plant community this could mean a confusing array

of standards. The average administrator cannot recognize and differentiate soil types. This is not necessary with standards developed for a major plant community since they are broad enough to be usable in most situations over an extensive area such as half a state. It is probable that as our knowledge of soils increases we will want to define standards for broad differences in soil, as for example between soils of granitic origin and those derived from basalt.

3. Another school advocates the use of a single indicator as the primarily consideration in judging condition—for example, composition. In selecting composition as an example of a single primary indicator it is not done to belittle its importance, because it is certainly true that for most plant communities floristic composition is a very important indicator. In this respect Dyksterhuis' (*5*) concept of segregating plants into groups which decrease, increase, or invade as grazing pressure changes warrants intensive further investigation. But for most mountain range types composition alone cannot be used to the exclusion of other site criteria such as density, vigor, litter, and soil characteristics. For example, vigor of forage plants is the most sensitive indicator of grazing pressure. The greatest weakness in its use as an indicator usually is a lack of adequate criteria which will permit its ready recognition.

The most valuable standards for judging condition of vegetation on mountain lands are those which give due consideration to all factors including density, composition, and vigor. The most important standard for judging soil is that which defines degree of stability. Some of these elements may be given more weight that others such as has been provided for in the range condition score cards which have been developed by the Forest Service for several important range types in the West.

4. Up until recent years we have grouped both vegetation and soil together into a single expression of "range condition." Similarly we have thought of trend as including both. To some it is unthinkable to separate the two. In primary plant succession soil and vegetation develop concurrently; but successional changes in plant cover are usually more rapid than soil changes. Thus a deteriorating plant cover may not be accompanied by marked soil losses. This is especially noticeable on many mountain meadows and parks where the terrain is level. It may also be observed for example on steep slopes where the spaces between the original bunchgrasses may have become covered with moss but the original soil mantle is largely intact. Conversely an improving plant cover may not be immediately accompanied by reductions in soil losses for there often is a lag between betterment of vegetation and soil condition. It is suggested that in order to be more specific about the meaning of "range condition" and to secure greater uniformity in its appraisal we employ two expressions—forage or vegetation condition and soil condition.

## Trends of Range Condition

The question of whether or not a range is improving or deteriorating or if in top condition it is being maintained is of paramount importance in management. As Ellison (*6*) points out, trend is best measured by the significant changes that have occurred in forage cover and soil between some point of time in the past and the present. Except in extreme situations, predictions as to what the current trend may be, are generally shaky. Present criteria for judging current trend are so weak that highly trained ecologists may even disagree as to what is happening on a specific area and yet the matter of judging or measuring trend is more important than the recognition of condition because a sure knowledge of trend is essential to sound management.

In some mountain range types, such as meadows, change may be rapid. However, in many mountain range types, particularly in the unsatisfactory condition classes, changes from year to year, even without grazing use, are extremely slow. Significant changes in either plant cover or soil may require a decade or more to become evident. Even these changes may not be recognized if the sole record of the area is someone's memory. There is a vital need for periodic records on both public and private ranges to tell us the magnitude of changes that we can expect under grazing use and whether or not these lands are being satisfactorily managed. This will require careful record taking at 5- or 10-year intervals on permanently established plots, transects, or "benchmarks" and should include photographs. The meaning of the data obtained should be summarized and interpreted in the field. This can be accomplished with the aid of range condition score cards (*11*) or check lists. It need not be tedious nor a prohibitive task if the men are given adequate training and the record taking is limited to the main essentials.

A periodic range condition survey, similar in purpose and magnitude to the present forest resources survey is a real need for effective land management. Such a survey is certainly well warranted in the West where watershed, range, timber, and recreational values are so closely intermingled and so important to the region's economy. Such a survey would do much to alleviate many of our present difficulties in attaining proper range use and it would certainly be an effective means of watching our grass bank account.

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# Role of the States and Private Timber Owners in Cooperative Forest Pest Control

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INSECTS AND DISEASES are not limited by state lines or other political or ownership boundaries. The problems arising from their ravages are of community interest, and should be dealt with on a cooperative basis. Cooperation and coordination of effort are essential for adequate detection, appraisal, and control of the major forest pests of this country. The task is so great that no one organization should undertake to provide the necessary manpower and facilities to cope satisfactorily with the problem in its entirety. It is an accepted fact that insects and disease kill more timber than does fire. As in fire control it is easier and cheaper to suppress outbreaks of forest pests before they get out of hand. Considerable progress has been made towards the development of a sound pest-control program, but much remains to be done.

A cooperative and coordinated forest pest-control program became a possibility in 1947 when Congress approved Public Law 110, better known as the Forest Pest Control Act. The law provides the authority for the federal government to cooperate with the states and private timber owners on surveys and control of forest pests. The primary purpose of the act is to "protect and preserve forest resources of the United States from ravages of bark beetles, defoliators, blights, wilts, and other destructive forest insect pests and diseases." To accomplish this, it provides for "surveys to detect and appraise infestations and to determine the measures which should be applied . . ." to control them. Nothing in the act implies that the federal government proposes to take over forest pest control on state and private lands. To the contrary, it makes possible full cooperation of federal agencies with state and private owners under certain prescribed conditions where the nation's timber resources are seriously threatened.

Funds for implementing the act were first appropriated in 1949 and have been made available each year since. Thus there exists a four-year history of operations under the terms set forth in Public Law 110. The procedures for carrying out the purpose of the act have been fairly well developed in a few states, but are hardly beyond the general discussion stage in others.

Many state and private foresters are asking the questions: What are our responsibilities under the Pest Act with respect to controlling forest pests on lands under our jurisdiction? How do we go about getting concerted action on forest lands held under varied and mixed ownership? How will we know when, where and how to control? What help can we expect from federal agencies—how may this help be obtained? And how do we go about getting full cooperation from all parties concerned with pest-control problems?

The purpose of this paper is to discuss these questions in the hope that past experiences may suggest opportunities in other areas where forest values may be seriously threatened by destructive pests.

No one will disagree with the premise that the primary duty of a forester—federal, state, or private—who is charged with the responsibility of managing forested land is to protect those forests against serious loss or destruction by any enemy whatsoever. Furthermore, no one should disagree with the philosophy that small, localized insect outbreaks can and should be handled by personnel under the direction of the local forester and that the control work should be financed by the forest owner. Where new or introduced pests are involved, however, or where native pests threaten extensive timber stands involving numerous owners, satisfactory control over large units can be obtained only by concerted and prompt action on the part of everyone concerned.

## Surveys

The U. S. Bureau of Entomology and Plant Quarantine maintains a small staff of specialists trained

in survey and control methods at its field stations located in each of the broad forest regions of the United States and Alaska. It is the responsibility of these men to conduct surveys and to train forest personnel, representing private, state, and federal agencies, to recognize and report incipient outbreaks of dangerous insects. Furthermore, it is their job to coordinate the detection survey reports; to examine in detail all forest areas where these surveys indicate serious threats from insect pests; to make appraisal surveys of such areas where needed, as a basis for control recommendations; and to give technical guidance and assistance on all control projects.

As already indicated, by federal survey staff in each region is small, being composed of only two to four men. It cannot, therefore, conduct region-wide detection surveys without organized help. It is here that state and private foresters can make an important contribution in the field of pest control. They, too, can detect and report insect infestations. Furthermore, they should be able to do this in line with their regular duties, with little or no added expense.

As the survey program becomes fully operative, an increasing number of training or "bug" schools of a day or two's duration will be held at strategic points within each state to acquaint local foresters with their pest problems. Under the guidance of forest entomologists they will be taught to recognize the insect species and type of damage most likely to be encountered and most likely to cause serious losses if left unchecked. In other words, they will learn what to be on the lookout for. At the same time they will learn what they can ignore, with reasonable assurance that no serious losses will take place. They will be taught how and where to make their reports so that they will be most useful. Without this initial help from area foresters and those who spend a large proportion of their time in the forests, it is impracticable to conduct state-wide, region-wide, or country-wide detection surveys. This type of cooperation requires no enabling legislation. It does, however, require the active interest and participation of all concerned.

Appraisal surveys—those necessary to size up infestations uncovered by the detection surveys—are made for the purpose of delineating the boundaries of outbreaks, determining their severity in terms of acres or number of trees infested, and locating them on a map. They furnish the basis for decisions on the feasibility of control operations and, in respect to smaller outbreaks, the basis for conduct of control operations. They may be made either from the air or the ground. The bureau conducts this type of survey on federal, state, and private lands, and not infrequently with some assistance from other agencies. Students in forestry and entomology supervised by experienced workers are usually employed during the summer months to make up the crews conducting the ground surveys. Aerial surveys are conducted by highly trained observers. As a matter of fact, any available qualified person may be assigned to help out on these surveys, since special legislation is ordinarily not needed to permit this sort of cooperation.

## Control Projects

Pest-control projects on federal lands are financed by the federal government. On state-owned lands they are usually financed in full by the particular state in which they occur. In instances where epidemics occur on private lands, the control project may qualify under the Pest Act. When it does, it becomes the joint responsibility of private, state, and federal agencies, with its cost being shared jointly. No hard-and-fast rule can be made as to what type or types of situation will qualify, and no set formula for proportional sharing of costs has been developed. Under most circumstances, however, it is felt that the federal government should not be expected to bear more than one-third of the cost of control on private lands. An exception, of course, would occur in case of a newly introduced pest that might be eradicated or contained in a small area by prompt action.

At present, federal participation in the control of outbreaks on lands of mixed ownership is dependent upon the following three requirements: (1) the epidemic constitutes a threat to timber resources of the nation; (2) an effective method of control is available; and (3) the state and private owners contribute substantially to the cost of control. The ultimate decision as to the extent to which the federal government will participate rests with the Secretary of Agriculture. Thus far, this has varied from one-fourth to one-third of the total cost on private lands.

## State Legislation

Some states now faced with forest pest-control problems on private lands, or likely to be faced with them in the future, have need for legislation that will give them the authority and financial backing to cooperate with private owners and the federal government. Such a law can be rather simple. What is needed is merely the granting to some agency, such as the state forester's office, of the authority to cooperate with private owners and the federal government in protecting forest resources of the state. It may or may not specify cooperative effort on pest control within districts designated by the forester, but it would be advantageous for it to do so. In other words, it can be a fairly general law, since it is unnecessary to spell out all the conditions under which it applies.

It would be preferable to leave its application and administration to the judgment of a state board capable of deciding upon the merits of each case. It should, of course, carry a provision for making cooperative funds available, since the expenditure of funds is necessary under the Pest Act, regardless of the nature of the contribution—whether made in terms of money, men, supplies, or other materials used on the job.

One state has a law on its books that makes private contributions mandatory within previously declared "pest control districts."

This state has the legal right to enter and conduct control operations on private forest land where the owner, after due notification, has failed to do so. Furthermore, this state can assess the owner for the cost of work done on his lands. Other state legislatures in considering the problem have been slow to invoke such police powers, preferring to handle pest control entirely on a voluntary basis. Both systems are in use today and both are working satisfactorily.

Whenever emergency outbreaks occur on prjvate land and it is to the best interest of private owners and the state to operate under the terms of the Pest Act, it is important that someone within the state be designated to coordinate the control work. Usually this is the state forester, state entomologist, or other pest-control official having an interest and responsibility in forest protection.

Where infestations have involved state and private lands in addition to those under federal management, control projects have been successfully administered, through mutual agreement, by the regional forester or someone designated by him. This too has worked well, and in the interest of economy should be continued. In pest-control projects supported wholly or in part with federal funds, the Bureau of Entomology and Plant Quarantine has, heretofore, coordinated the surveys, and has given technical advice and assistance on the control project. The success of this procedure would seem to warrant its continuance.

### Conclusion

As a final word, it may be said that remarkable progress has been made in the detection and control of widespread forest-insect outbreaks under the provisions of the Pest Act. The success of the cooperative efforts to control the spruce budworm outbreaks in the Pacific Northwest is indication enough that the philosophy of cooperative endeavor as envisaged by the act is sound. In looking to the future, however, and to the possibility of insect and disease outbreaks developing in the forests of any one of our 48 states, it is suggested that the attainment of the following three objectives would mean a long step toward our goal of adequate protection of the valuable timber resources of the country from destruction or serious losses from insects and diseases wherever they occur:

1. Strengthening of detection surveys by enlisting the services of all qualified forest personnel in observing and reporting threatening or alarming conditions. This can be done through an awakened interest by all foresters in protection from insects and diseases, and through a series of cooperative training schools held at strategic points throughout the states.

2. Enactment by all states before emergencies arise, rather than after serious epidemics are well under way, of legislation to provide the authority and financial backing required for cooperation with private owners and the federal government on pest control. The simple expediency of being able to act promptly in matters pertaining to pest control will often save much timber and many dollars.

3. Designating some state official, such as the state forester, with authority to a coordinate the pest-control work within each state.

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## Look for the December Issue . . . . .

Commemorating the fiftieth anniversary of the publication of a professional periodical devoted to forestry, Henry Clepper, managing editor of the JOURNAL, highlights its history in *The Journal of Forestry: An Historical Summary of the First Fifty Years.* Appearing next month, this article will emphasize the major aspects of the development of professional literature since the *Forestry Quarterly* first appeared in 1902. Of equal significance, it also reminds foresters of "the early spadework of those who planted the tree whose fruits we gather." The many men who have given "generously of their time and talents, without pay and without expectation of gratitude" are, for the first time in this publication, credited with their most valued contributions to our professional literature.

# Effect of Moisture Supply and Soil Texture on the Growth of Sweetgum and Pine Seedlings

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*Knowing the response of sweetgum* (Liquidambar styraciflua *L.*) *and pine* (Pinus taeda *L. and* P. echinata *Mill.*) *seedlings to the important factors of site quality would be very helpful in trying to distinguish pine and hardwood sites in the Southeast. Sweetgum is a strong competitor of the pines on many sites and seedling behavior partially determines the adaptability of a species to a site. This study compares the growth of 1-year-old potted sweetgum and pine seedlings during one growing season in soils of three different textures and under three levels of moisture supply. Although the sweetgum seedlings produced more dry matter and developed larger root systems, the growth in length of leaders and branches was less than that of the pines under all conditions of the experiment.*

THE NECESSITY for distinguishing pine and hardwood sites, which has been emphasized recently by the widespread and increasing use of hardwood control measures in the southern pine region (*2*), is another aspect of the ever-present problem of fitting species to site.

Choosing the right species for a particular site depends on a knowledge of the requirements of the possible choices at all stages of growth, from the germinating seed to the mature tree. The seedling stage, however, is especially sensitive to site conditions; consequently a knowledge of seedling behavior is an essential part of the information needed to judge the suitability of a site for the species in question. The sprouting ability of hardwoods is, of course, an important factor in the choice between pine and hardwoods because it increases the cost of hardwood control. It is not so closely related to potential hardwood productivity, however, because trees of seedling origin are favored in hardwood management.

In the Southeast, sweetgum (*Liquidambar styraciflua* L.) is one of the more desirable hardwoods, especially on the better sites, and one of the earliest competitors of loblolly (*Pinus taeda* L.) and shortleaf pine (*Pinus echinata* Mill.) in the successional trend. Knowledge of the seedling behavior of these three species, therefore, should be especially helpful in distinguishing pine and hardwood sites.

With these points in mind a study was undertaken to learn something of the effect of soil texture and moisture supply on the growth of seedlings of these three species. Of the many factors that determine the productivity of a forest site, moisture supply is probably the most important (*8*). The availability of water to plants is strongly influenced by physical soil characteristics (*9*). Sandy soils contain less readily available moisture (that between field capacity and the permanent wilting point) at field capacity than heavier soils. Water is not equally available throughout the available range—in light soils most of the available water is held by a force of less than one atmosphere while in heavy clays 50 percent or more of the available water usually is held by a force of more than one atmosphere (*6*). Water availability is also influenced by the concentration of the soil solution but this factor usually is of little importance in humid localities.

Plants also differ in their capacity to absorb water, mainly because of differences in transpiration rate, amount of absorbing root surfaces, and permeability of root tissues. Kozlowski (*4*) found that at low soil moisture the transpiration rate was lower in loblolly pine than in overcup oak. Dogwood, black locust, and white oak seedlings inherently have more extensive root systems than loblolly pine (*3, 5*). Higher root-shoot ratios are also favored by the greater photosynthetic efficiency of the hardwoods. Many hardwoods reach maximum rates of photosynthesis at about one-third full sunlight while loblolly pine needs full sunlight (*1, 7*). Kozlowski (*4*) found that white oak more than retained this photosynthetic advantage over loblolly pine as soil moisture was reduced, and Bormann (*1*) observed the same behavior in sweetgum. Since internal water deficits distinctly limit growth and elongation (*6*), the physiological advantages of hardwoods suggest that they can grow better than pine under adverse conditions yet it is commonly observed that the growth of hardwoods is retarded more than that of loblolly and shortleaf pine on poorer sites.

## Procedure

Seedlings of the three species, loblolly pine, shortleaf pine, and sweetgum, 1-0 stock, were grown in 5-quart cans in the greenhouse through one growing season in soils of three different textures and under three levels of watering. The study was carried out in a randomized block design with three replications. This design required 27 seedlings of each species, one to each pot. Pots were assigned at random to blocks and treatments. Each block of 9 seedlings of each species, was placed in a different part of the greenhouse and pots were assigned at random to places on the greenhouse bench.

A supply of each soil was obtained in the field, screened to remove larger stones, and the moisture equivalent (or field capacity in the case of Louisburg sand), permanent wilting point, textural fractions, and organic matter content determined (Table 1). The soils used were Georgeville B horizon (clay), Georgeville A horizon

[1]The author expresses his appreciation for the advice and guidance given by Dr. Paul J. Kramer, Botany Department, Duke University, during all phases of this study.

TABLE 1.—SOIL CHARACTERISTICS

| Soil series | Soil type | Horizon | Sand | Silt | Clay | Organic matter | P.W.P. | M.E. | Available water |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Percent* | | | | | | |
| Georgeville | Clay | B | 14.9 | 39.1 | 46.0 | 5.4 | 9.1 | 25.1 | 16.0 |
| Georgeville | Silty clay loam | A | 20.2 | 56.4 | 23.4 | 4.4 | 6.2 | 23.8 | 17.6 |
| Louisburg | Sand | Azonal | 80.0 | 13.0 | 7.0 | — | 2.3 | 13.5[1] | 11.2 |

[1]Field capacity instead of moisture equivalent. Determined by draining soil column until moisture content stabilized.

(silty clay loam), and Louisburg sand. Georgeville and Louisburg are common soil series in the North Carolina Piedmont.

The seedlings were potted during the winter and maintained without treatment until growth started. Pots were fertilized at the rate of 1,000 pounds per acre with 6-10-6 fertilizer to compensate for any serious lack of fertility. Treatments consisted of (1) maintaining the moisture content at the moisture equivalent (m.e.), (2) watering to m.e. when the moisture content dropped to 60 percent of available water, and (3) watering to m.e. when moisture content dropped to 20 percent available water. The moisture content of the soil at the time of potting was determined and pot, seedling, and soil were each weighed. These values were used to compute the combined weight of pot, seedling, and soil for the soil moisture content that required watering. Pots were weighed every other day throughout most of the growing season and once a day during exceptionally hot, dry weather. Light intensity in the greenhouse, although not measured, was probably less than full sunlight but considerably more than one-third, thus favoring the sweetgum somewhat.

Toward the end of the growing season, after growth was substantially complete, the seedlings were carefully washed out of the pots. For each seedling the growth in length of the leader and all branches was measured and root and top were weighed, both fresh and dry.

## Results

Growth in length and fresh weight are shown in Table 2. Loblolly and shortleaf pine did not differ significantly in any of the measured characteristics, hence these measurements were averaged together.

Growth in length of pine exceeded that of sweetgum under all conditions. Sweetgum apparently was more sensitive than the pines to soil texture differences; sweetgum growth differed significantly by both soil and watering while pine growth differed only by watering. The interaction of soil texture and watering treatment was not significant in pine growth; that is, the effect of watering on the growth of pine in one soil was not significantly different from that in another. That comparison was not made with sweetgum because mortality was heavy and the observations were too few to test any but main effects.

Although growth in length was less in sweetgum than in pine, fresh weight increase was more in all but one category. The greater fresh weight increase was not due to greater moisture content of the sweetgum seedlings, for final moisture contents of sweetgum and pine were 63 percent and 71 percent, respectively, and the small difference was not significant. Production of dry matter therefore actually was greater in sweetgum than in pine, in accordance with the greater photosynthetic efficiency of the hardwood. The root-top ratios (Table 2) show that the proportion of the dry matter increase used in the growth of the root system was greater in sweetgum than in pine.

Sweetgum therefore behaved in accordance with its physiological advantages over pine — higher photosynthetic rate and greater water absorption—by producing a larger amount of dry matter. The development of the inherently larger root system absorbed a so much greater proportion of the total photosynthate in sweetgum, however, that its top growth was less than that of pine. The larger root system, even though it probably contributed substantially to the greater absorptive capacity of the hardwood, therefore cannot be regarded as having been an advantage with respect to growth in length at this stage of seedling development and under the conditions of this experiment.

The larger root systems are usually regarded as favoring the survival of hardwoods during dry periods that result in high mortality of pine, because hardwoods reach deeper layers of soil where competition for moisture is less severe. That factor could scarcely have entered into this experiment where the restricted volume of soil in the pots was dried down more uniformly by the seedlings than soil in place. Table 3 shows the number of each species that died during the experiment in each of the three

TABLE 2.—GROWTH OF SWEETGUM AND LOBLOLLY AND SHORTLEAF PINE UNDER THREE LEVELS OF WATERING ON THREE SOILS

| Factor level[1] | Sweetgum Watering | Sweetgum Soil | Loblolly and shortleaf pine Watering | Loblolly and shortleaf pine Soil |
|---|---|---|---|---|
| | Growth in length | | | |
| | *Centimeters* | | | |
| 1 | 35.8* | 33.9* | 91.6* | 59.5 |
| 2 | 27.1 | 17.5 | 52.6 | 61.4 |
| 3 | 4.0* | 6.0* | 28.2* | 11.1 |
| | Increase in fresh weight | | | |
| | *Grams* | | | |
| 1 | 53.6* | 50.0* | 38.4* | 27.9 |
| 2 | 37.1 | 31.9 | 28.0 | 29.8 |
| 3 | 17.1* | 3.6* | 14.2* | 6.3 |
| | Root-top ratios (dry weight) | | | |
| 1 | 0.82 | 0.73* | 0.26 | 0.32 |
| 2 | 0.75 | 0.85 | 0.34 | 0.20* |
| 3 | 0.97 | 1.65* | 0.27 | 0.43* |

[1]Definition of factor levels:

*Watering*

1. Kept at m.e.
2. Watered to m.e. at 60% available water.
3. Watered to m.e. at 20% available water.

*Soil*

1. Georgeville B horizon, clay.
2. Georgeville A horizon, silty clay loam.
3. Louisburg (azonal), sand.

*Vertically aligned asterisks indicate significantly, or highly significantly, different quantities.

soils. Differences between species were not significant.

TABLE 3.—MORTALITY (NUMBER OF SEEDLINGS DEAD[1])

| Soil series and horizon | Loblolly | Shortleaf | Sweetgum | Total |
|---|---|---|---|---|
| Georgeville B | 2 | 3 | 2 | 7 |
| Georgeville A | 3 | 5 | 2 | 10 |
| Louisburg | 7 | 8 | 8 | 23 |
| Total | 12 | 16 | 12 | 40 |

[1]Out of 9 in each species-soil combination at the beginning of the experiment.

Differences in mortality among watering treatments (not shown in Table 3) were not significant, nor was the mortality in relation to watering in one soil different from that in another. The effect of soil on mortality was highly significant, however, many more seedlings having died in the sandy soil than in either of the two heavier soils. The reason for this high mortality in the sandy soil is not clear. The higher mortality encountered on sandy soils in the field is usually attributed to low moisture retention, but in this study the effect of watering on mortality was the same for all three soils. It is possible that the seedlings were not watered frequently enough during the initial period before treatments were started, which would have subjected the seedlings in the sandy soil to greater moisture stress since all were watered equally at the same time intervals. The mortality occurred uniformly throughout the growing season, however. Apparently some characteristic of soil texture other than its effect on moisture relations was responsible for the high mortality in the light soil, but this study furnishes no evidence of its indentity.

These results prompt the conclusion that under the condition of this experiemnt the pine seedlings did at least as well as the sweetgum seedlings. Mortality of sweetgum was no greater than that of pine and sweetgum produced more dry matter; but in growth in length, which determines eventual dominance, pine exceeded sweetgum. These seedlings probably grew somewhat differently than they would have in these soils in the field because of the unnatural conditions imposed by greenhouse and pots, but the extent of the difference is not known.

## Summary

Potted 1-year-old seedlings of three species, loblolly pine, shortleaf pine, and sweetgum, were grown in the greenhouse through one growing season in soils of three different textures and under three levels of watering. Each species-soil-watering combination was replicated three times. Observations were growth in length (terminal plus lateral), increase in fresh weight, and final dry weights of roots and tops, for each seedling.

Loblolly and shortleaf pine did not differ significantly in any respect and were compared with sweetgum together. Pine exceeded sweetgum in growth in length under all conditions but sweetgum exceeded pine in fresh weight increase, and dry weight root-top ratio.

Within species, comparisons of growth in length and fresh weight increase (and therefore dry weight increase also) showed that sweetgum growth differed significantly by both soil and watering while pine growth differed only by watering. Sweetgum therefore seemed to be more sensitive than pine to soil texture differences.

Mortality differed significantly only among soils, being significantly greater in the sand than in the clay or the silt loam.

The principal conclusion was that, under the conditions of this experiment, the pine seedlings did as well as the sweetgum seedlings, and since growth in length determines eventual dominance, showed some slight advantage.

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# Notes

## What is a Profession?

*The following excerpt is from an address by Dr. Lloyd E. Blauch, associate chief for education in the health professions, U. S. Office of Education, presented at the interprofessional conference called by the Southern Regional Education Board in Atlanta, August 19. It is the considered opinion of an educator with many years of experience working with professional societies.*

*Foresters may find the statement of interest in view of the discussion during the past several years on the professional qualifications for membership in the Society and on what constitutes professional training in forestry.*—EDITOR.

[The following are] some of the principal earmarks of those occupations that are widely and commonly recognized as professions. . . (1) a profession is based upon specialized and prolonged study and training; (2) while the services by its members are performed for a fee or a salary, their success is not measured by financial standards but rather by their accomplishments in serving the needs of people; and (3) its members are organized into associations which assume responsibility for maintaining and improving the quality of its service. Let us briefly examine these features.

First, as to the specialized intellectual side of a profession. The principal distinguishing characteristic of a profession today is the possession of a technique which enables the members to perform a particular service and which is acquired through prolonged study such as that represented by at least four years in a professional college or university. The technique—I am using this term broadly to denote method of procedure essential to expertness in any art or science—is based upon a body of scientific or institutional knowledge and skills and attitudes which have been organized into a program of professional preparation that is appropriate for inclusion in the offerings of a university. A profession involves essentially intellectual operations although in many instances a high degree of manual skill may also be required. Its course of training is a combination of theory and practice which is enforced through a series of educational requirements and, in many instances, an examination system provided by the State.

Second, while professions are paid for their services the foundation of their efficiency is professional spirit rather than the desire for gain. Although men may enter a profession for the sake of livelihood, the measure of their success is the service which they render, not the financial gains they amass. Professional men may, as in the case of a successful physician, grow rich, but the meaning and significance of their profession, both for themselves and for the public, is not that they make money but that their service brings health to their patients, knowledge to their students, protection to their clients. The driving force of a professional man is normally not merely money, rather it is the satisfaction that he obtains from rendering a service well, from gaining the esteem of his fellow professionals, from living up to the solidly established tradition of the little society or professional group in which he moves, from discharging the professional obligation in which he has been indoctrinated. . . . Here is one of the reasons why the professions are generally held in high social esteem. A truly professional man is a dedicated man; he has espoused the high ideal of service to his fellow men.

It is possible, of course, to idealize the professions too much. Unfortunately every professional group includes some members who do not live up to its standards of unselfish service. A few, by their conduct, demonstrate that their greatest, in fact their sole concern, is for financial gain, but they are not typical of the profession as a whole. Moreover, at times a profession as a whole engages in practices which are hardly in the interest of the public welfare, such, for examples, as unduly restricting the number of persons admitted and opposing the development of new and competing techniques and forms of organization. One occasionally hears the question raised whether some of the professions in our day are not tending to be unduly influenced by the commercial spirit of the times.

Third, professional men associate with others engaged in the same type of service; from one another they draw inspiration and acquire new ways of performing their services; to one another they freely contribute their ideas, their discoveries, and their inventions. They form associations which are motivated by such purposes as (a) to distinguish the qualified from the unqualified, through admission to membership; (b) to promote a high standard of professional character and honorable practice; (c) to raise the status of the profession through public recognition acquired in part through organization and collective action; (d) to promote and encourage the use of the profession whenever it can be of service, and (e) to serve as a source of authoritative information and advice within their own sphere as the public has need for such assistance. In recent years, particularly in times of national emergency, we have seen the Government make much use of some of the professional associations, and I am certain that in the future it will turn to them even more than in the past and the present.

It is a common practice for these professional associations to develop and adopt statements of principles, ideals, and regulations to guide practitioners in their conduct. These codes of ethics, as they are generally called, are characteristic

of all well established professions. We are told that nowhere have standards of professional ethics been so extensively formulated in codes as in the United States.

The professions acting through their associations engage in many other activities that are aimed at improving their service. They take an active interest in the establishment and maintenance of schools for training the future members of their professions, they foster and support research related to their service, they create a body of professional literature, and they make definite provision through such means as conferences, seminars, and clinics whereby practitioners share their knowledge and experience.

## Cutting Schedule for Even-Aged Bottomland Hardwoods

A question sometimes arises as to the best stocking and cutting treatment for even-aged bottomland hardwoods on good sites. Since experimental evidence on such stands is meager, theories cannot be strongly supported. Table 1, however, is an attempt to formulate an enlightened opinion from personal observations. It is thought to be appropriate for various bottomland types, including pure or mixed stands, but it probably is inapplicable to very poor sites. It cannot be used in pure stands of yellow-poplar, sweetgum, cottonwood, willow, tupelo, or baldcypress.

The table will be chiefly useful, perhaps, in handling small patches of trees that can be considered single-aged, for it is unlikely that even-aged management can or should be imposed on an entire compartment or logging unit. Regenerating patchy many-aged stands by even-aged methods would sacrifice too much immature timber, and even if this loss were accepted, heterogeneous regeneration and growth rates over a large area would prevent the crop trees from reaching maturity simultaneously.

The table assumes that a cut will be made each time that the stand has grown 2 inches in average d.b.h. If the schedule has been consistently followed, the estimated total cumulative yield for any given average d.b.h. may be calculated by summing the "cut" column down through the given d.b.h. and then adding the amount in the "left" column for that particular d.b.h. Thus, estimated total board-foot yield for a well-managed stand averaging 18 inches in d.b.h. would be 870 + 1,100 + 1,430 board feet cut plus 9,010 currently left: a total of 12,410 board feet. The cordwood yield would be 23.5 cords cut from trees under sawtimber size, plus an additional 1 to 1.5 cords of top wood for each 1,000 board feet of sawlog volume.

For tracts in which past treatments have not corresponded to recommended cut and leave, the table sets up desirable residual stands for current and future cutting. For example, a forester who is initiating management in a stand with an average d.b.h. of 18 inches would be advised to leave for future growth about 58 average or better trees per acre, or a basal area of 102.5 square feet in trees classified as desirable growing stock. Depending on defect, vigor, and original stocking, this might entail a heavier or lighter cut than is recommended in the table. If the desirable growing stock already comprises less than 58 trees or 102 square feet of basal area per acre, cutting of any such growing stock would best be deferred. Any poor risks, overmature trees, and culls should, of course, be cut regardless of recommended growing-stock levels.

Table 1 and the examples above assume a cutting cycle equal to the estimated time required for average diameter to increase 2 inches—a period that might be anywhere from 4 to 15 years. The table may be used for any cycle, however, by estimating D (the average diameter of the stand at the end of the cycle) and then leaving (at the beginning of the cycle) the *number* of trees shown in the table for D minus 2. In the preceding example, if it were desired to operate on a 15-year cycle, and it were estimated that the present 18-inch stand will be 24 inches at the end of the cycle, then the D—2 would be 22 and the forester would leave 42 trees. The basal area of these 42 trees now (when they are 18 inches) would be (42 × 1.767) or 74.2 square feet per acre.

The table assumes that no mortality will occur in a well-managed stand since all poor risks will have been cut. The notable difference between individual tree volume of

TABLE 1.—RECOMMENDED RESIDUAL STAND AND CUTTING SCHEDULE PER ACRE, FOR A HYPOTHETICAL EVEN-AGED BOTTOMLAND HARDWOOD STAND ON A GOOD SITE

| Average d.b.h. at time of cut | Recommended number of trees | | Recommended basal area | | Estimated volume | |
|---|---|---|---|---|---|---|
| | Left for growth | Currently cut | Left for growth | Currently cut | Left for growth | Currently cut |
| | | | | | *Rough cords (128 cu. ft.)* | |
| *Inches* | *Number* | | *Square feet* | | | |
| 2 | 862 | 1,258 | 18.8 | 27.4 | | |
| 4 | 475 | 387 | 41.5 | 33.8 | 9.6 | 3.0 |
| 6 | 295 | 180 | 57.9 | 35.3 | 13.3 | 4.5 |
| 8 | 202 | 93 | 70.5 | 32.5 | 17.2 | 5.0 |
| 10 | 147 | 55 | 80.2 | 30.0 | 19.7 | 5.5 |
| 12 | 112 | 35 | 88.0 | 27.5 | 22.3 | 5.5 |
| | | | | | *Bd. ft. (Doyle rule)* | |
| 14 | 87 | 25 | 93.0 | 26.7 | 4,955 | 870 |
| 16 | 71 | 23 | 99.1 | 29.3 | 7,165 | 1,100 |
| 18 | 58 | 13 | 102.5 | 23.0 | 9,010 | 1,430 |
| 20 | 49 | 9 | 106.9 | 19.6 | 10,850 | 1,620 |
| 22 | 42 | 7 | 110.9 | 18.5 | 12,695 | 1,750 |
| 24 | 36 | 6 | 113.1 | 18.8 | 14,400 | 1,980 |
| 26 | 31 | 5 | 114.3 | 18.4 | 16,180 | 2,200 |
| 28 | 27 | 4 | 115.5 | 17.1 | 17,945 | 2,360 |
| 30 | 23.8 | 3.2 | 116.8 | 15.7 | 19,800 | 2,340 |
| 32 | 21.0 | 2.8 | 117.3 | 15.6 | 21,380 | 2,540 |
| 34 | 18.7 | 2.3 | 117.9 | 14.5 | 22,735 | 2,580 |
| 36 | 16.5 | 2.2 | 116.6 | 15.6 | 23,010 | 2,920 |
| 38 | 14.6 | 1.9 | 115.0 | 15.0 | 25,172 | 2,960 |
| 40 | 0 | 14.6 | 0 | 127.4 | 0 | 29,055 |

a cut tree and a leave tree in an evenaged stand reflects the fact that cut trees are usually smaller, shorter-bodied, more defective, and more tapered than leave trees. It need hardly be said that the upper limit of diameter is somewhat arbitrary and does not constitute a recommendation that crop trees generally be held until they reach 40 inches d.b.h.

Recommendations as to the best treatment for uneven-aged bottomland hardwoods will be found on page 47 of *Management of Bottomland Hardwoods*, Occasional Paper 116 of the Southern Forest Experiment Station.

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## Redcedar Cumulative Volume Tally

The form shown below is a helpful tool in the selective marking of stands of eastern redcedar (*Juniperus virginiana*). Many foresters have proved the utility of the cumulative volume tally. The JOURNAL has presented several forms, from their introduction by Macon and Gevorkiantz[1] to a recent analysis of their efficiency by Miller.[2]

This redcedar form gives volumes in units of 10 board feet for the usual range of sizes. To obtain the board foot volume of a single tree, read the first value for that size tree in the table and multiply by 10. In addition to a tally of sawtimber volume, the form provides space for tallying the number of posts by trees three inches and larger in d.b.h.

Board foot values are built up from volume tables constructed for redcedar in the Tennessee Valley.[3] Volume is by the log scale recently adopted by the cedar industry. Basically this is the "two-thirds" rule, *applied at the small end of the log*. The formula is $V = \frac{L(\frac{2}{3}D^2)}{12}$ where V is volume in board feet; D is diameter in inches, inside bark at small end, and L is length in feet.

The volume of redcedar trees of usual sizes that scale 1,000 board feet by the Cedar Industry Rule would scale between 500 and 1,000 board feet by the standard International ¼-inch rule, and from 1,200 to 1,300 board feet by the Modified International ¼-inch rule described by Grosenbaugh and Arend.[4] The volume has not been checked with an actual mill tally.

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[2]Miller, Charles I. A methods study of the cumulative volume tally sheet. Jour. Forestry 47: 25-28. 1949.

[3]Zimmerman, A. H. and Sara M. Potts. Cedar volume tables for the Tennessee Valley. Tech. Note No. 8. TVA Div. For. Relations. 4 pp., mimeo. 1952.

[4]Grosenbaugh, L. R. and John L. Arend. International rule modified for small eastern redcedar logs. Jour. Forestry 47: 736-739. 1949.

REDCEDAR TREE VOLUME TALLY CUMULATIVE BY TREES
CEDAR INDUSTRY (⅔) LOG RULE.

| DBH inches | LOGS 8 Ft. | CUT VOLUME — 10 BOARD FEET — | TOTAL | POSTS IN TOP3 NUMBER | LEAVE VOLUME — 10 BOARD FEET — | TOTAL | POSTS IN TOP3 NUMBER |
|---|---|---|---|---|---|---|---|
| 5 | 1 | 0.4 1 1 1 2 2 3 3 3 4<br>4 4 5 5 5 6 6 6 7 7 | | | 0 1 1 1 2 2 3 3 3 4<br>4 4 5 5 5 6 6 6 7 7 | | |
| 6 | 1 | 0.6 1 2 2 3 4 4 5 5 6<br>7 7 8 8 9 10 10 11 11 12 | | | 1 1 2 2 3 4 4 5 5 6<br>7 7 8 8 9 10 10 11 11 12 | | |
| | 2 | 1.1 2 3 4 6 7 8 9 10 11<br>12 13 14 15 16 18 19 20 21 22 | | | 1 2 3 4 6 7 8 9 10 11<br>12 13 14 15 16 18 19 20 21 22 | | |
| 7 | 1 | 1.0 2 3 4 5 6 7 8 9 10<br>11 12 13 14 15 16 17 18 19 20 | | | 1 2 3 4 5 6 7 8 9 10<br>11 12 13 14 15 16 17 18 19 20 | | |
| | 2 | 1.5 3 4 6 8 9 10 12 14 15<br>16 18 20 21 22 24 26 27 28 30 | | | 2 3 4 6 8 9 10 12 14 15<br>16 18 20 21 22 24 26 27 28 30 | | |
| | 3 | 2.2 4 7 9 11 13 15 18 20 22<br>24 25 29 31 33 35 37 40 42 44 | | | 2 4 7 9 11 13 15 18 20 22<br>24 26 29 31 33 35 37 40 42 44 | | |
| 8 | 1 | 1.4 3 4 6 7 8 10 11 13 14 | | | 1 3 4 6 7 8 10 11 13 14 | | |
| | 2 | 2.0 4 6 8 10 12 14 16 18 20 | | | 2 4 6 8 10 12 14 16 18 20 | | |
| | 3 | 2.8 6 8 11 14 17 20 22 25 28 | | | 3 6 8 11 14 17 20 22 25 28 | | |
| 9 | 2 | 2.5 5 8 10 12 | | | 2 5 8 10 12 | | |
| | 3 | 3.5 7 10 14 18 | | | 4 7 10 14 18 | | |
| | 4 | 4.7 9 14 19 24 | | | 5 9 14 19 24 | | |
| 10 | 2 | 3.1 6 9 12 16 | | | 3 6 9 12 16 | | |
| | 3 | 4.2 8 13 17 21 | | | 4 8 13 17 21 | | |
| | 4 | 5.6 11 17 22 28 | | | 6 11 17 22 28 | | |
| 11 | 3 | 5.0 10 15 20 25 | | | 5 10 15 20 25 | | |
| | 4 | 6.8 13 20 26 32 | | | 6 13 20 26 32 | | |
| 12 | 3 | 5.8 12 17 23 29 | | | 6 12 17 23 29 | | |
| | 4 | 7.5 15 22 30 38 | | | 8 15 22 30 38 | | |
| | 5 | 9.4 19 29 38 48 | | | 10 19 29 38 48 | | |
| 13 | 3 | 6.7 13 20 27 34 | | | 7 13 20 27 34 | | |
| | 4 | 8.5 17 26 34 42 | | | 8 17 26 34 42 | | |
| | 5 | 10.8 22 32 43 54 | | | 11 22 32 43 54 | | |
| 14 | 3 | 7.7 15 23 31 38 | | | 8 15 23 31 38 | | |
| | 4 | 9.6 19 29 38 48 | | | 10 19 29 38 48 | | |
| | 5 | 12.2 24 37 49 61 | | | 12 24 37 49 61 | | |
| 15 | 3 | 8.8 18 26 35 44 | | | 9 18 26 35 44 | | |
| | 4 | 10.7 21 32 43 54 | | | 11 21 32 43 54 | | |
| | 5 | 13.6 27 41 54 68 | | | 14 27 41 54 68 | | |
| 16 | 3 | 9.9 20 30 40 50 | | | 10 20 30 40 50 | | |
| | 4 | 11.9 24 36 48 60 | | | 12 24 36 48 60 | | |
| | 5 | 15.1 30 45 60 76 | | | 15 30 45 60 76 | | |
| 17 | 3 | 11.0 22 33 44 55 | | | 11 22 33 44 55 | | |
| | 4 | 13.1 26 39 52 66 | | | 13 26 39 52 66 | | |
| | 5 | 16.6 33 50 66 83 | | | 17 33 50 66 83 | | |
| 18 | 4 | 14.4 29 43 58 72 | | | 14 29 43 58 72 | | |
| | 5 | 18.1 36 54 72 90 | | | 18 36 54 72 90 | | |

Location: _____

Area: _____ A.

Plot: _____

Tallied by: _____

Date: _____

| DBH | TREES WITH POSTS, NO LOGS 0 | 1 | 2 | 3 | 4 | TOTAL TREES | TOTAL POSTS | TREES WITH POSTS, NO LOGS 0 | 1 | 2 | 3 | 4 | TOTAL TREES | TOTAL POSTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | |
| ALL | | | | | | | | | | | | | | |

AHZ & SP/RD — TVA DIVISION OF FORESTRY RELATIONS — DECEMBER 1951

## 2, 3, 5-Triphenyl Tetrazolium Chloride as a Viability Indicator of Certain Coniferous Seeds[1]

An accurate determination of seed viability prior to field sowing is of great importance in agriculture and forestry. The proper quantity of seeds to be sown is largely dependent upon the quality of the seeds. Direct germination, the most widely accepted method of seed testing, is not entirely satisfactory because of the time and environmental controls required.

Seeds can also be tested by quicker indirect measures, physical and biochemical. Recently, tests involving the use of 2, 3, 5-triphenyl tetrazolium chloride have been reported as a possible biochemical method of determining seed viability. Since the use of tetrazolium promises a test of viability in less than 24 hours, even with seeds showing delayed germination, the development of such a test for forest tree seeds is highly desirable. To explore such a possibility, four species of coniferous seeds were employed. They were ponderosa pine, western white pine, piñon pine, and Douglas-fir.

To obtain bases of comparison, the seeds were first tested for viability by two methods: (a) direct germination tests, and (b) excised embryo tests.

Tetrazolium chloride is colorless in water solution, but is reduced to form carmine red triphenyl formazans by living cells. This reduction is believed to be due to enzyme activity. The standard test consists of removing the seed coats, soaking the seeds in water, cuttting the endosperms to expose the embryos, immersing the seeds in a one percent solution of tetrazolium, and interpreting the subsequent staining of the tissues. In some cases, this procedure failed to produce the complete straining of all viable embryos, as indicated by comparison with excised embryo tests. In a subsequent study of the effect of pre-treatment on staining, the writer found that prior to immersion in tetrazolium, a 4 to 10 day period in a moist chamber was more conducive to accurate staining than a period of soaking in water.

The first tests were concerned only with the viability of the naked embryo. The results compared closely with those of the excised embryo test, but the results of both methods were significantly higher than the germinative capacity measured by sand flat tests. The presence of dead endosperm tissue in seeds with viable embryos appeared to be an explanation of the differences; this led to a study of the effect of dead endosperm tissue on seed germination, upon which was based a tentative set of staining standards for the interpretation of tetrazolium tests.

The use of this set of standards in a series of tests with each of the four lots of seeds, produced results which correlated closely with the results of direct germination tests. The value of such tests to the nurseryman, seed dealer, and forester in general is evident.

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[1]An abstract of a thesis presented in partial fulfillment of the requirements for the degree of Master of Science in the School of Forestry, Montana State University, June 1952.

## Formation of Quality Classes for Second-Growth Douglas-Fir Logs Based on Lumber Grade Recovery[1]

An investigation of the relationship between log surface characteristics and lumber grade recovery was made at two small mills which were typical of the small mill in the Douglas-fir region. The study was made on 467 second-growth Douglas-fir logs within the diameter range of 8 to 27 inches, inclusive.

The logs were studied as to maximum knot size, number of knots of maximum size, total number of knots, presence of clear quarters, rate of growth, log length and diameter, and occurrence of deductible defect. Logs having shake, split, decay, or other deductible defect were not included in the study.

The lumber from each log was followed through the mill, graded and tallied on a study form designed for this purpose. The surface characteristics of each log were recorded on the same form.

The data were analyzed using three variables which were shown to have a definite correlation to lumber quality. These are: (1) the occurrence of clear quarters, (2) maximum knot size, and (3) rate of growth (as measured by the percent of log diameter having less than six rings per inch). The two measures of lumber quality found to be most suitable for the analysis were the percent of Selects including Clears, and the percent of No. 1 Common and Better lumber recovered.

The results of the analysis indicate that for this study, the following conclusions can be drawn:

1. Logs having one or more clear quarters produce a decidedly higher quality lumber recovery than do logs having no clear quarters.

2. Maximum knot size shows a definite correlation to the quality of the lumber recovery. This relationship indicates that the quality of the lumber recovery varies inversely with the maximum-size knot contained in the log.

3. Rate of growth (as measured by the percent of log diameter in medium plus coarse grain) is of most importance in the 1-inch knot size class, of less importance in the 2-inch knot size class, and of little importance in the 3- to 7-inch knot size classes.

4. Log diameter and number of knots have no important effect on the quality of the lumber recovery.

This analysis indicates that second-growth Douglas-fir logs may be divided into quality classes based

[1]Abstract of thesis presented for M.S. degree in forest products, Oregon State College, Corvallis, April 25, 1952.

on lumber grade recovery as affected by the presence of clear quarters, maximum knot size, and the rate of growth. The specifications for suggested quality classes based on the relationship stated above are included.

This analysis also indicates that quality classes might be established which would aid in the quality cruising of second-growth Douglas-fir stands. Such a classification is based on the lumber grade recovery as affected by presence of clear quarters, and maximum knot size only as rate of growth is impractical to determine in the standing tree. Specifications for quality classes on this basis are also included.

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## Federal Tax Treatment of Gains and Losses on the Cutting of Timber

As a general rule, foresters are not familiar with the special provisions of the federal income tax law, sections 117(j) and 117(k) which were enacted in 1943 and 1944. These provisions deal with the treatment of gain or loss which may be said to be realized at the time timber is cut.

The purpose of this article is to explain these sections in relatively simple language to enable foresters to better understand that part of the business end of the forest products industry. Actual application of the provisions in the preparation of income tax returns will, however, require a more thorough investigation into the Internal Revenue Code.

Ordinarily, no gain or loss is realized until an asset is sold or exchanged. However, Section 117 (k) provides that a taxpayer may elect to treat the mere *cutting* of timber as a sale or exchange, provided.

1. The timber is cut for sale or for use in his trade or business; and

2. The timber is his own, or he has a contract right to cut it; and

3. The timber has been owned or the contract has been held for more than 6 months prior to the beginning of his taxable year.

If these three conditions exist, and the taxpayer elects to come under this section, the realized gain or loss will be the difference between the fair market value of the timber as of the first day of the taxable year in which it is cut, and the cost of such timber adjusted for depletion. The advantage of electing under 117(k) is that the gain or loss realized at the time the timber is *cut* will receive special treatment under 117(j), explained fully below, which in effect subjects such gains to a maximum tax rate of 25 percent (the Revenue Act of 1951 increases this to 26 percent for corporations with taxable years beginning after March 1951 and for individuals with taxable years beginning after October 1951), but allows such losses to be deducted in full. In contrast, if the timber is cut and no election is made under 117(k), the income from the actual *sale* of the logs will be ordinary income which is taxable at graduated rates, usually considerably higher than 25 percent, according to the taxpayer's total income.

It is important to note that when a taxpayer makes this election, it applies to all timber which qualifies under 117(k) at that time or in the future, and is binding for that taxable year and for all subsequent years, unless the Commissioner of Internal Revenue permits the taxpayer to revoke the election. It should also be noted that the fair market value determined is then considered to be the taxpayer's cost of the cut timber for all income tax purposes.

It has been found that in many cases, taxpayers who elect under 117(k) are experiencing great difficulty in determining "fair market value" as of the first day of the taxable year in which the timber is cut, and are often setting too *low* a figure. The tax officials have stated that consideration must be given to the character and quality of the timber, quantity of timber per acre, accessibility of the timber, and freight rates by common carrier to markets. It is up to the taxpayer to satisfy the tax officials that the fair market value he is using is reasonable for the stumpage in question. The timber in each case must be valued according to its own merits, not according to general averages for regions or counties. The tax officials, however, in trying to ascertain the accuracy of the fair market value selected, will consider actual sales and transfers of similar properties in the area, the margin between cost of production and price realized for timber products, valuation for state and local taxes, disinterested appraisals by approved methods, or any other facts and evidence bearing on market value of the stumpage.

It is important that the fair market value be determined with the utmost care and accuracy. If the fair market value is set as high as possible, the taxpayer will realize the maximum gain on the transaction which will be to his advantage because of the provisions of 117(j).

Section 117(j) provides that the taxpayer must group all gains and losses from the following sources:

1. From timber cut which the taxpayer elects to consider as sold or exchanged under the provisions of 117(k) as explained above.

2. From timber held for more than 6 months which is disposed of under a contract by virtue of which the owner retains an economic interest in the timber (e.g., a cutting contract).

3. From the sale, exchange or involuntary conversion (that is, destruction in whole or part, theft, seizure or requisition, or condemnation) of real or depreciable property used in the trade or business of the taxpayer which has been held for more than 6 months.

4. From the involuntary conversion of capital assets held for more than 6 months (capital as-

sets are all property *except* inventoriable assets, property held for sale to customers in the ordinary course of the taxpayer's business, depreciable business property, and real property used in the taxpayer's trade or business).

When such gains and losses are grouped, if a net loss results, such loss is *fully deductible* from taxable income. But, if a net gain results, this gain is includible with other "long-term" capital gains and losses (i.e. gains and losses from the sale or exchange of capital assets held for more than 6 months). Without elaborating in detail concerning the capital gains and losses provisions of the law, it can briefly be said that the tax on net "long-term" capital gains never exceeds 25 percent (increased to 26 percent under the Revenue Act of 1951).

One example should serve to clarify why these provisions are advantageous and why the determination of the fair market value of the timber cut is of the utmost importance. The example assumes the sawmill operator to be single, merely to avoid complicating this issue by the so-called "split income" provisions of the law applicable to married individuals. It also assumes that the operator is *not* a corporation, for in that case the tax computation would be different, although the net result with regard to the tax treatment of cut timber would be the same.

## Example

John Jones, a sawmill operator, has a total taxable income for the calendar year 1951 of $50,000 which *includes* an estimated gain on timber cut. He cut a million feet of timber during the year for sale or for use in his own business, which he owned for more than 6 months prior to the beginning of his taxable year. (Since the facts comply with the three requirements of 117(k), he has elected to treat the cutting as a sale or exchange for the purpose of determining gain at that time). He paid $1 per thousand for the timber when he purchased it in 1932. He has determined the fair market value of the stumpage as of the beginning of his taxable year to be $11 per thousand, resulting in a gain of $10,000. Actually the fair market value is $21 per thousand, resulting in a gain of $20,000 realized on the cutting of the timber, but Mr. Jones didn't realize the importance of effecting a *maximum* gain on the cutting of this timber. Assume Mr. Jones had no other gains or losses to be grouped under 117(j), and had no long term capital gains or losses from the sale or exchange of capital assets:

| | Fair market value $11. Long term capital gain of $10,000 | | Fair market value $21. Long term capital gain of $20,000 | |
|---|---|---|---|---|
| **Determination of total income** | | | | |
| Woods operation | | | | |
| Fair market value of 1,000M board feet cut as of 1/1/51 | $11,000[1] | | $21,000[1] | |
| Cost at $1 per M | 1,000 | | 1,000 | |
| Capital gain on stumpage | | $10,000 | | $20,000 |
| Sawmill operation | | | | |
| Net proceeds from sale of lumber | 51,000 | | 51,000 | |
| Cost of logs | 11,000[1] | | 21,000[1] | |
| Ordinary income | | 40,000 | | 30,000 |
| Total Income | | 50,000 | | 50,000 |
| [1]As stated above, the fair market value determined is considered to be the taxpayer's cost of the cut timber for all income tax purposes. | | | | |
| **Tax computation** | | | | |
| Ordinary net income | 40,000 | | 30,000 | |
| Less his exemption | 600 | | 600 | |
| Net taxable (exclusive of capital gain on timber cut) | 39,400 | | 29,400 | |
| Tax on ordinary income | 19,642 (in 69 percent bracket) | | 13,078 (in 63 percent bracket) | |
| Tax on long-term capital gain at 25 percent | 2,500 | | 5,000 | |
| Total tax, calendar year 1951 | 22,142 | | 18,078 | |
| | Note: This ordinary income is taxed at 69 percent; capital gain at only 25 percent. | | Note: This ordinary income is taxed at 63 percent; capital gain at only 25 percent. | |

By increasing the fair market value of the timber cut to a higher and more accurate figure, two advantages are derived:

1. Ordinary taxable income is decreased in amount and so is subject to tax at a lower rate (in this example 63 percent instead of 69 percent.)

2. The amount of capital gain is increased, and long-term capital gain is taxable at a maximum rate of 25 percent, regardless of how much other income the taxpayer has.

The Revenue Act of 1951, in addition to increasing tax rates on ordinary income and increasing the maximum tax on long term capital gains to 26 percent, made certain changes in the mechanics of computing income taxes for individuals with taxable years beginning after October 19, 1951, but the basic principles regarding capital gains or losses on the cutting of timber as set forth above are unchanged.

## Summary

1. If the three conditions outlined above are met, the taxpayer may elect to consider the mere cutting of timber as a sale or exchange for purposes of computing gain or loss on that timber. [117(k)].

2. If the taxpayer so elects, the gain or loss realized (difference between fair market value at beginning of year and cost) must be included with other gains and losses listed above to determine whether there is an aggregate gain or loss. If an aggregate gain results (assuming no other long term capital gains or losses), such gain is subject to a maximum tax rate of 25

percent (26 percent for corporations with taxable years beginning after March 1951 and for individuals with taxable years beginning after October 1951); if an aggregate loss results, it is fully deductible. [117(j)].

3. If no election is made under 117(k), any gain from the sale of the logs will be taxable at graduated rates (usually considerably more than 25 percent) according to the taxpayer's total income. Any loss realized will be fully deductible.

4. It is advantageous to maximize capital gain and to minimize ordinary income by arriving at the highest fair market value possible for the timber cut, because long term capital gains are taxable at a maximum rate of 25 or 26 percent. To this end, fair market value should be determined carefully and accurately.

The increasing importance of taxation and the necessity for a tax conscious public cannot be overemphasized. In this connection, it may be of interest to note that based on the same income figures used in the example above, Mr. Jones' tax for the calendar years 1950, 1951, and 1952 is as follows:

| | Fair market value $11. Long term capital gain of $10,600 | Fair market value $21. Long term capital gain of $20,000. |
|---|---|---|
| 1950 tax | $20,071 | $16,676 |
| 1951 tax (as above) | 22,142 | 18,078 |
| 1952 tax | 24,136 | 19,876 |

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## What Do Foresters Hope to Accomplish in Forest Genetics?

I have recently had occasion to review the American literature on forest genetics and was struck with the ever-increasing quantity and quality of forest genetics research in this country. I was especially impressed with the gradual development of concepts and ideas, culminating, perhaps, in R. A. Brink's and E. J. Schreiner's articles[1] in the JOURNAL OF FORESTRY. There have been no further comments in the JOURNAL on their proposals and so I would like to take this opportunity to discuss the subject in the light of these publications and some other related observations.

The early American pioneers in forest genetics were concerned largely with seed source. R. Zon in 1913 and C. P. Willis in 1915 published on seed source of Douglas-fir. In 1916 Nils B. Echbo discussed the importance of source of seed in forestation and a few years later G. A. Pearson and W. G. Wahlenberg reported on western yellow pine seed source. J. Roeser and Franz Fankhouser in 1926 and 1931, respectively, published significant articles on seed source in the JOURNAL OF FORESTRY.

Starting about 25 years ago, there was an awakening interest in forest tree breeding and Lloyd Austin, F. I. Righter, and others reported on the early activities, especially at the Eddy Tree Breeding Station in California (now the Institute of Forest Genetics). More recently E. J. Schreiner, Palmer Stockwell, Righter, and others have been active in tree hybridization and controlled breeding and H. I. Baldwin has contributed outstanding work on seed problems.

Although the earliest American genetics literature was concerned mostly with seed source, actual tests have borne fruit only within the last 10 or 15 years. There have been several cases of outstanding and even spectacular results proving again that relatively local seed sources are usually superior to sources from distant regions. Possibly as a result of these successes there has been a large increase of seed source tests and more in the planning stage. For example, The Committee on Southern Forest Tree Improvement has prepared a *Standardized Working Plan for Local Tests of Seed Source*, dated October 25, 1951. This is all to the good and the plan should promote sound research on seed source. However, there is, perhaps, some danger of over-emphasis of seed source work at the expense of other pressing forest genetics problems.

This brings us back to the JOURNAL OF FORESTRY articles of Brink and Schreiner, already cited. Schreiner puts his major emphasis on a program of forest genetics employing hybridization and controlled breeding. He believes seed source or racial studies should be continued but does not stress this type of forest genetics work. Brink outlines an over-all three-point research program as follows: (1) improving the genetic quality of seed used for forestation purposes, (2) selection of superior trees or stands by progeny tests, and (3) producing improved strains by hybridization and controlled breeding. He mentions geographic seed source to state that only seed from suitable climatic races should be considered for forestation purposes.

Thus we have, in this country, perhaps a none-too-desirable situation. Hybridization and controlled breeding, considered important by both Brink and Schreiner, is being carried out in only a few places and in a much too restricted manner. Seed source tests, considered much less important because the essential basis has already been established, are apparently on the increase among forestry research agencies not equipped to do controlled breeding. On the other hand, the important over-all and immediately practical problems of genetic seed quality and progeny tests for superior trees are probably receiving less attention than any of the other major phases of forest genetics.

[1] Brink, R. Alexander. A prospective view of forest tree breeding in Wisconsin. Jour. Forestry 47:813-818. 1949.
Schreiner, E. J. Genetics in relation to forestry. Jour. Forestry 48:33-38. 1950.

In simple terms, what do American foresters hope to accomplish by a research and action program of forest genetics? I would like to mention the following six objectives:

1. Reduce the present retrogressive genetic selection in natural regeneration caused by cutting practices which merely "cream" or "high-grade" the forests.

2. Determine and use the correct seed source or racial strains for species to be planted on any given area. Thanks to past research in Europe and this country, positive action toward this goal can be taken. However, further research is still justified if one or more of the following purposes are served.

a. To define the specific limits of range within which the seed of a given species should be collected.

b. To determine the best geographic source for species not native to the region where they are to be planted. For example, loblolly and shortleaf pine on old fields or spoils banks in southern Illinois and Indiana.

c. To justify sound seed procurement policies by proof of the usual superiority of local seed sources. The evidence on this point is already impressive.

3. The third objective is to prevent seed collection policies and methods which result in retrogressive genetic selection. This is largely an action program and leads naturally into the next objective.

4. Actually improve the genetic quality of seed used for forestation work (Brink's first point). As Professor Brink points out, limited but significant progress can be made by selection of superior stands and individuals and their use for seed production. This is chiefly an action program although careful records of progeny would do much to "prove" a given seed tree or stand.

5. Progeny tests of elite trees or stands to detect superior genetic sources for seed collection or further breeding work (Brink's second point). This is wholly research and deserves special attention from agencies equipped for it but not for breeding work. I believe that part of the present emphasis on seed source should be switched to progeny tests. Here are pressing problems that have hardly been touched in this country, which require many years for completion, and which promise relatively great rewards.

The argument for greater emphasis on progeny tests looking toward the determination of elite seed producers has several angles. There is, of course, the European experience as reported by Lindquist.[2] In Sweden elite seed producing stands and individuals are already in use. There can be little doubt that such superior tree genes do exist and that they can, in some measure, be located and utilized. For example, Munger and Morris[3] found that progeny from certain parent trees in two localities made outstandingly better height growth than all others tested. The parent trees, in the meantime, had been cut and thus could not be utilized. There are two similar cases in my own experience. One was strikingly superior native red spruce nursery stock from a particular seed source in West Virginia. The second involved significant differences in height growth of progeny from many different felled trees of loblolly pine.[4] Further efforts to test and utilize the first discovery apparently were not made and, in the second case, all the loblolly progeny were cut to make way for flooding by an artificial lake!

The contention here is that progeny tests can be made by research agencies *not equipped to do controlled breeding*, that they are little more expensive than geographic seed source tests, and that they will give relatively large rewards for the money spent.

Progeny tests, however, are fraught with pitfalls and these must be avoided to produce acceptable results. Some of the more obvious precautions are as follows:

a. Collect seed from particular elite trees or stands which can be identified and protected for long periods of time.

b. Plant progeny where they will have maximum safety from destruction or changes in land ownership.

c. Confine a particular test to one geographic area, that is, do not confound seed source heredity with that of other tree characteristics. Separate tests may be made in other geographic areas.

d. Grow all stock of a given test in a single bed of one nursery, preferably a nursery located in the study area.

e. Plant progeny in square or rectangular plots 1/10 to ¼ acre in size and make only about 6-10 progeny comparisons in a single block. Blocks should be replicated at least 4 times to provide statistical evaluation and insurance against total loss if some blocks are destroyed.

f. Progeny should be planted on the proper site quality for the species involved. This is important. It would be useless to test black walnut progeny, for example, on an upland eroded old field. In some cases it may be necessary to plant in forest soil by girdling or removing the existing overstory.

g. Make a real effort to locate truly elite seed sources, divorced as much as possible from factors of environment or past history.

6. The sixth objective in a program of forest genetics is research in hybridization and controlled breeding. This was the third point given by Brink and constitutes the bulk of the program urged by Schreiner. In the long run this could be perhaps the most important of all. Together with progeny testing for superior trees it should probably constitute the major portion of our forest genetics program.

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[2]Lindquist, Bertil. Genetics in Swedish forestry practice. The Chronica Botanica Co., Waltham, Mass. 1948.

[3]Munger, T. T. and W. G. Morris. Growth of Douglas fir trees of known seed source. Tech. Bul. 537, U. S. Dept. Agric., Washington, D. C. 1936.

[4]Minckler, L. S. One-parent heredity tests with loblolly pine. Jour. Forestry 40:505-506. 1942.

## Forest Soils Not Depleted By Timber Harvest

Dr. Chester T. Youngberg, forest soil scientist, has recently completed an extensive research project for Weyerhaeuser Timber Company, and has determined on the basis of his study that soils are not being depleted in spite of the tons of timber harvested.

According to Youngberg, an average acre of Douglas-fir forest land may yield 400 tons of wood at the time of harvest; but only a small portion, actually less than 1 percent by weight, is made up of soil nutrients—nitrogen and other inorganic compounds.

Trees produce prodigious quantities of wood, perhaps as much as 20,000 cubic feet per acre. However, the tree returns the minerals and nutrients to the soil in the form of leaf litter, according to Youngberg, and soil organisms decompose this into its original constituents for use again by the tree. The wood which is removed at the time of log harvest is made up largely of water (which may account for as much as half of the wood by weight) and organic compounds. These latter compounds, mainly cellulose, lignin, resins, and waxes, are manufactured by the tree from air and water and are not obtained from the soil. Their chemical constituents are carbon, hydrogen, and oxygen. The mineral elements, such as nitrogen, phosphorus, potassium, calcium and magnesium which are taken up from the soil, are largely returned to the soil as leaf fall and only a small portion of these inorganic compounds end up in the wood. The near century required to produce a log crop permits depletion to be more than counterbalanced by the weathering of minerals in the soil, the addition of nitrogen by rainfall, and the action of nitrogen-fixing soil organisms.

# Reviews

**Uncle Sam in the Pacific Northwest.**

By Charles McKinley. 673 pp. University of California Press, Berkeley. 1952. $7.50.

As a faculty member of Reed College in Portland, Charles McKinley has held a "ringside" seat at the arena in which rival federal agencies fight over the fabulous water resources of the Columbia. He has had extended experience on the Pacific Northwest Regional Planning Commission and with the efforts for coordination within the Department of Interior. He has witnessed much of the battle of the last dozen years over proposals for a Columbia Valley Authority, in which believers in public ownership and integrated resource planning are pitted against private utilities, Chambers of Commerce, and many business groups like the National Reclamation Association.

With this background, Prof. McKinley has written a remarkable study of public administration of natural resources in the Columbia Valley. In realistic detail and with many case histories, he tells the story of some twelve federal agencies active in this area; how they function, where they overlap or conflict, and how they cooperate with one another or fail to cooperate. It is the most complete and informative picture of the federal resource bureaus in action that this reviewer has ever seen.

The author's inventory of natural wealth on the lands draining into this 1,200-mile river is of special interest to foresters. One-half of the 180-odd million acres is forest land. Another 40 percent is range, with many instances of overgrazing and serious erosion. The valley supplies one-third of the national production of lumber and one-sixth of its woodpulp. Sixty-two percent of the factory workers in the basin are employed by forest industries; but the annual growth of wood is rated at only one-third of the overall drain.

The resource of staggering proportions is water. The yearly flow in the Columbia could supply 155 million acre-feet, six times as much as the ultimate consumption for irrigation. The possible economic development of hydroelectric power, beyond all prospective needs for domestic water and irrigation, is put by McKinley at 20 to 30 million kilowatts of continuous energy. This is over six times the capacity now installed. Cheap power sets the stage for the future economy, and watershed conservation will weigh heavily in upstream management.

The three federal giants of western river engineering come to the front in Prof. McKinley's account of expanding and often clashing bureaucracies. The Bureau of Reclamation started with the irrigation of arid lands; the Engineer Corps of the Army with navigation and flood control; the Bonneville Power Administration with the sale of hydroelectric energy. But all these agencies have moved toward a common goal. This is the complete development of a river system and its multiple uses for all public services and benefits, including recreation and fisheries. In priority between different uses, however, the common goal is colored by the primary interest, the first love, of each agency.

The evolution of three organizations toward the same conception of overall river management has followed one enactment after another in a bewildering maze of federal legislation. The whole development is typical of the haphazard, uncorrelated processes of American democracy; also of the effectiveness of political pressures under aggressive leadership. It illustrates, as well, the American genius for technological advances on an enormous scale, and our zest for the "bigger and better."

Boulder Dam and the legislation of 1928 launched the Bureau of Reclamation upon river management for multiple uses and controls of water. It has become the greatest producer of electric power in the world. Its functions in river engineering now largely duplicate those of the Corps of Engineers. But the Bureau has never lost its primary interest in irrigation. When the completion of Bonneville Dam put vast additional electric energy at the disposal of Uncle Sam, its distribution and sale might logically have been assigned either to the Reclamation Bureau or the Corps of Engineers, both experienced and organized for this duty. But Congressional advocates of the TVA type of valley management forced the compromise of 1937. It brought forth the Bonneville Power Administration, dedicated to the maximum production of public power and its distribution. The sale of Grand Coulee power was subsequently turned over to Bonneville Power Administration. One result of this new *force majeure* in the Columbia Valley is the lowest regional power rate in the United States, $17.50 per kilowatt year, and a per capita consumption of electricity 2½ times the national average.

The official line of each of the three giant agencies is *cooperation*. There have been many gestures and some genuine efforts to unify technical procedures and harmonize projected plans. But actual cooperation, as depicted by Prof. McKinley, is a partial and patchwork affair. There is still no fundamental unity. There is still a vast duplication in engineering organizations and expenditures, and keen rivalry over new legislation and appropriations.

One of the basic difficulties in reaching a correlated program is the difference in viewpoints over priority in water uses and the question of who should pay the enormous bills. The Bureau of Reclamation wants to put water on the settlers' land at the lowest possible cost and under seasonal schedules most favorable to agriculture. Bonneville wants the most and the

cheapest power under the steadiest year-round load. The Corps of Engineers regards as its foremost obligation the handling of reservoirs so as to maintain desired navigation levels and reduce the extremes of high and low water. Seemingly, there has yet been no authoritative determination of these basic priorities in the management of the Columbia.

McKinley's first premise is that the federal government must provide leadership, overall planning and assistance to the people and states of the Northwest in the development of the Columbia Basin. Th's is implicit in the high proportion of national land ownership and the close relations with states and private undertakings forced by the nature of the situation. How can Uncle Sam make a better job of redeeming his responsibilities?

The Tennessee Valley Authority is cited as a model in solving interagency conflicts and providing the good things of life. The author's description of TVA's benevolent paternalism is idyllic to the point of arousing the suspicions of a hard-bitten reviewer of New England ancestry. We are warned, however, that similar results are not necessarily assured in other valleys.

The example of TVA prompted Senator Pope's bill of 1935 to create a Columbia Valley Authority along similar lines, but including the development of irrigation. Senator Murray, through his Missouri Valley Bill of 1944, set the stage for a stampede of valley authority legislation.

The pressure for a CVA was heightened by the destructive floods in the lower Columbia in 1948. While the Bureau of Reclamation and the Army Engineers were working toward agreement on a $3 billion water storage program, President Truman, in a special message to Congress, urged legislation for the management of the Columbia. Eighteen senators signed the administration bill, S-1645. Prof. McKinley says it is the best Columbia Valley bill yet written.

This measure would make CVA a public corporation, operating under the Congress. It would take over, on the Columbia, the duties of the Reclamation Bureau, the Army Engineers, and Bonneville Power Administration. It would not replace the land-resource agencies. It could work through them or supplement their activities, at its own discretion. It would be responsible for planning the conservation and use of all natural resources in the watershed and for the research necessary to this function. It would submit a complete annual program for each coming year and be charged with the systematic allocation of costs of all public expenditures. *And* it could acquire any private utility.

Prof. McKinley, however, does not accept the valley authority program with its independent regional satraps as the best form of integrated resource management. It does not assure similar treatment for similar resource problems throughout the nation, the utilization of well equipped central services like the Forest Products Laboratory at Madison, or the restraint of sectional and provincial tendencies. It does not provide for new resource developments that may become of high significance to national or international well being, like atomic fission. Resource management should be reorganized on *national* as well as *regional* considerations.

The author favors, in substance, a National River Development and Management Administration in a "re-named" Department of Interior. It would include the civil functions of the Corps of Engineers, the cost allocations and rate-fixing of the Federal Power Commission, the power transmission and marketing duties of Bonneville Power Administration and other like organizations, and the engineering-construction functions of the Bureau of Reclamation. Within such a national agency, it would be desirable to provide for decentralized, quasi-corporate, regional organizations like CVA, exercising the maximum authority consistent with national policy and direction.

A parallel consolidation of agencies dealing with public land resources, including Interior's Bureau of Land Management, is suggested within the Department of Agriculture. It should also function through decentralized regional administrators corresponding to the set-up for river management. McKinley favors the merging of all related activities and responsibilities of each of the departments under unified regional administrations, leaving only policy and budgetary controls and central service or research functions to the Secretary and his overhead staff. As the keystone of the arch, McKinley would place a representative of the Office of the President in each region. The President's deputy would coordinate departmental programs and budgets, take the lead in regional advisory activities and state relations, and keep an eye on the observance of national policies.

## On Book Reviewing

"It cannot be supposed that book reviewing touches only authors and publishers. It is good for the reviewers and thus extends the influence of the journal to the effects upon the circles of the reviewers. To be forced to read critically, to collect one's wits, to exercise discrimination, to summarize and compare, to get down on paper something well and succinctly expressed (a difficult and rarely accomplished feat)—these make arduous demands on a man's higher faculties. Such activity keeps the mind supple, sharpens the sense of responsibility, and might ultimately teach him who engages in it to write."

WILLIAM B. HAMILTON in
*Fifty Years of the South Atlantic Quarterly.*

The most interesting part of *Uncle Sam in the Pacific Northwest* is the story of bureau relations, of personalities and political pressures—all interwoven with the rise of resource agencies and policies. There is the interplay of client groups forming behind federal bureaus. The National Reclamation Association was created when Director Mead asked the help of the West against the opposition of Midwestern and Eastern agricultural interests. The National Rivers and Harbors Congress, backers of the Corps of Engineers and the oldest and most powerful of pressure groups, has many direct alliances within the government. Two power-minded secretaries, Ickes and Krug, drove hard for "multiple use" in river management. It is all a very realistic recital of American democracy in action.

Prof. McKinley is plainly on the side of public ownership and public enterprise in dealing with these resource problems. He distrusts the private utilities and other commercial interests that figure in the great drama of land, forests, and waters. His philosophy is all for integrated *public* planning and direction. In his pursuit of the best way to get on with it, he gives the reader a valuable source book on federal organization and the competition of resource-minded men and their ideas.

W. B. GRELLEY.

**A Regional Program of Forestry Training and Research in the South.**

By Commission on Forestry and Related Training. 55 pp. Southern Regional Education Board, Atlanta, Ga. 1952. 75 cents.

To grasp the full significance of this report it is necessary to have an understanding of the regional education program of the South.[1] This program, inaugurated in 1948,

[1]For a more complete description of this program see *The South's Regional Educational Program—a Progress Report, November, 1951*, Southern Regional Education Board, Atlanta, Ga.

# FOREST INVENTORY

STEPHEN H. SPURR, *University of Minnesota*

THIS UP-TO-DATE volume offers a comprehensive analysis of both the theory and methods of modern forest mensuration. Thoroughly re-examines and evaluates measurement techniques in the light of the increased use of aerial photography. In line with latest technical advances, the author describes simpler, more accurate methods of correlating forest volume and growth with measurements made on aerial photographs and on the ground. The book offers specific help on estimating volume of individual trees, direct estimation of stand volume, and the prediction of stand growth. Stresses the increasing importance of simplicity and low-cost methods. Includes important data made available by many forest agencies, both in this country and abroad. *30-page bibliography. 52 tables, 36 illus.* **$8.50**

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# FOREST MANAGEMENT

H. ARTHUR MEYER, *The Pennsylvania State College*; ARTHUR B. RECKNAGEL, *St. Regis Paper Co.*; and DONALD D. STEVENSON, *U. S. Dept. of Agriculture*

ALL THE FACTS and information needed today for successful forest management planning and practice. Stressing American techniques rather than classical European methods, the book thoroughly covers the general problems of forest organization, and principles and methods of forest regulation. Reflects the increasing transition from exploitation to management, emphasizing the need for bringing timber growth and drain into equilibrium and for managing forests on a sustained yield basis. **". . . of great value not only to students, who are the future managers of our forests, but also to practicing foresters who are managing public and private forests under sustained yield."—Photogrammetric Engineering.** 37 tables, 19 illus. $6.00

# AERIAL PHOTOGRAPHS in FORESTRY

STEPHEN H. SPURR, *University of Minnesota*

DESIGNED to help foresters solve many problems in less time, at lower cost, and with greater precision by using aerial photographs. Covering every aspect of aerial photography, this valuable book provides essential information on aerial surveying; photo-interpretation; applications to inventory-taking, mapping, and other management operations. Working techniques are explained in detail. Abundant illustrative material includes photographs, diagrams, and working graphs. **". . . the first complete treatise from which we may review . . . accomplishments of the pioneers, details of aerial surveys, and working principles, limitations, and possibilities of aerial photographs . . . should be widely read and appreciated."—Journal of Forestry.** 19 tables, 94 illus., $6.50

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is essentially a pooling of the higher educational resources of 14 southeastern states. By means of a thoroughgoing analysis of these resources it is proposed to avoid duplication of effort in the several states beyond the educational needs of the region, and at the same time provide for those needs not being adequately met at the present time.

The forestry phase of the program, reported upon in this publication, is under the direction of a Commission on Forestry and Related Training, composed of 17 members representing forestry education, and public and private forestry agencies. The secretary of the commission is Dr. William J. McGlothlin, consultant for professional programs of the parent board.

The report follows the objectives laid down by the southern regional education program. There is a rather complete inventory of the conditions surrounding forestry and forestry training in the South. Significant items in this category are that (1) forests are the logical crop of 55 percent of the land area of the South; (2) on the current level of management the forest lands are producing only about one-third of their potential capacity; (3) there are 2,500 professional foresters employed in the region; (4) additions to this force will be needed at the rate of 250 for each of the next five years; and (5) there are six accredited forestry schools in the region, with twelve other schools offering courses in forestry.

There is an implication that the professional educational needs can be met by the existing accredited schools with possible slight additions if, through cooperation among the schools, there is complete use of the resources. Subprofessional or vocational training is recognized as having a value in producing men to fill jobs on the foremanship level. There is a justified fear, however, that training on this level might be interpreted as being of full professional caliber, and thus dilute the stream of professional training by producing men incapable of making any great contribution to

raising the productive capacity of the forest lands.

The report sets forth the present offerings of the six accredited forestry schools, and the extent to which these schools are now cooperating among themselves and with the public and industrial agencies.

The appendix contains some very meaty material basic to the main body of the report. These data are grouped under 13 headings and appear for the most part in tabular form.

The South is to be commended for this pioneering regional approach to higher education. It is an approach that other regions of the United States will be forced to adopt if the challenge of rapidly increasing costs of higher education is to be met. The approach has within it the elements for considerable strengthening and improvement of all professional education. We of the forestry profession can be proud that our southern colleagues are playing such a prominent part in this new departure. The development can have an extremely important bearing on the future of all professional forestry education.

MYRON KRUEGER.

❦❦❦

**Wood is Wealth.**

Forestry Branch Bulletin 105. 52 pp. Illus. 1952. Department of Resources and Development, Ottawa, Ont., Canada.

**Forest and Forest Products Statistics.**

Forestry Branch Bulletin 106. 65 pp. Illus. 1952. Department of Resources and Development, Ottawa, Ont., Canada.

*Forests and Forest Products Statistics of Canada* replaces an older bulletin dated 1947; the one entitled *Wood Is Wealth* is new. The former is a "must" for all students of Canadian forestry conditions, especially of Canadian forest production and international trading in such products.

Approximately 80 percent of it consists of tables dealing with primary forest production by provinces, and detailed statistics of sawtimber, pulp and paper production volumes, values, and exports. Some of these tables go back as far as 1916, and all give the figures for each year at least as far back as 1926. These tables portray the interesting history of an expanding business, particularly pulp and paper, in a period of great changes in values and of increasing exports of paper and pulp, along with the ups and downs in sawn lumber trade, changes in its principal export markets, etc. These statistics may be considered as authentic and accurate.

The same cannot be said about the statistics which deal with the forests. Newfoundland (the island only, not Labrador) is included for the first time. The figures in previous bulletins are practically repeated in the new one for all the other provinces. These are the same as in 1945, except that Quebec's

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figures were amended in 1949, and are repeated now.

The inventory of Canada's provinces is proceeding at a fairly rapid rate. The federal government, except for national parks, Indian reserves, forest experiment stations, and the unorganized Northwest Territories and the Yukon, is not an owner of forest lands. The national parks and experimental areas cover only 29,382 square miles. Consequently, the statistics are based almost entirely on figures submitted by the provinces, the real owners of almost all the forests of Canada. Some provinces have better data on their forests than do the others.

It would appear that between 1945 and 1951, a period of high utilization, the areas of young growth must have been increased following the logging of virgin stands, and that the volume of sawtimber size should have decreased. This would happen properly during the logging of virgin stands under the best of forest management practices. On the other hand, changing standards of utilization and undercruising in the past probably operate to maintain the previous figures to a large extent. There are no substantial changes since 1945.

As indicated by the following figures, the tenure of forest land is unique. The total forest area is 1,299,759 square miles. Of this area, occupied lands total 293,928 square miles of which 96,708 square miles are in private ownership, fee simple; and 197,220 square miles are under licenses of various kinds. Unoccupied lands total 1,005,831 square miles, of which 283,818 square miles are in forest reserves and parks, and 722,013 square miles are unallocated and in Crown forests.

The tenure of Canadian forest lands and the taxation and other charges imposed on those who operate them are not favorable to good forest management. With a few inconsiderable exceptions, the forests have not been considered by Canadian legislators to be "factories" with great potentiality for growth. They are in general regarded as a storehouse of wood which belongs to "all the people."

This reviewer is one among the minority of foresters who believe that the importance of forest inventories for their own sake is overemphasized. Other more important matters should be tackled simultaneously, with the objective of bringing the best and most accessible forest lands under good management. If there is a lack of either personnel or money, fire-protection comes first. Next should be research into the economics of forest management, and silvicultural and logging techniques. Inventories, if necessary, should be placed last.

*Wood Is Wealth* is a good synopsis and description covering the years 1938 to 1949. It uses the same figures as in Bulletin 106 where necessary to support the text.

One noteworthy omission is that neither bulletin makes any reference to increment which is taking place, or to possibilities of increment in any area.

JOHN D. GILMOUR.

**Handbook of Engineering Fundamentals.**

Compiled by Ovid W. Eshbach. 1,170 pp. John Wiley & Sons, New York 1950. $10.

One of the series of Wiley engineering handbooks, this is the second edition of the work first published in 1936. In it are compiled a wealth of important basic facts and principles "upon which our technological and engineering advancement depends."

It was prepared by a staff of 39 specialists under the direction of Dean Eshbach of the Northwestern Technological Institute of Evanston, Ill. Among the contributors specializing in wood products and timbers are H. S. Hansen of the Illinois Institute of Technology and L. J. Markwardt of the Forest Products Laboratory.

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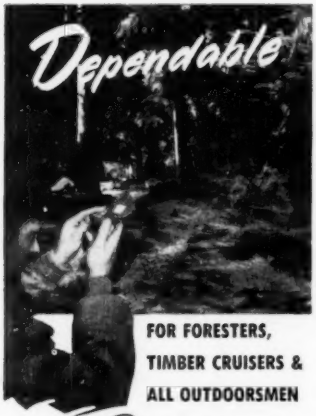


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Mechanics of deformable bodies, 76 pages.

Mechanics of incompressible fluids, 65 pages.

Aerodynamics, 116 pages.

Engineering thermodynamics, 98 pages.

Electricity and magnetism, 70 pages.

Radiation, light, and acoustics, 37 pages.

Chemistry, 38 pages.

Metallic materials, 100 pages.

Nonmetallic materials, 105 pages.

Engineering law, 23 pages.

Index, 52 pages.

The average woods forester might not have much use for a handbook of this kind, but research men, teachers, students, and workers in the ever-expanding fields of forest products utilization and wood technology will doubtless find it a most useful work. There are frequent references throughout the book to engineering properties of lumber, timber, wood, cork, and other forest products.

Despite the more than 1,100 pages the book is not heavy. It is well bound in a flexible cover. A strong, light-weight grade of paper has been used. The type is legible, and the numerous figures are sharp and clear.

HENRY CLEPPER.

❦ ❦ ❦

**The Best Loved Trees of America.** By Robert S. Lemmon. 253 pp. Illus. Doubleday and Company, Inc., New York. 1952. $3.50.

This book is a collection of superb tree portraits, both photographic and written, featuring 58 selected North American species and one introduced European tree.

No evident arrangement of species has been followed, either bo-


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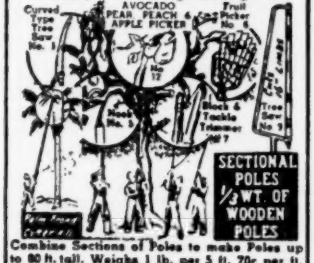

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tanical or geographical, but perhaps the nontechnical reader will not object to this, as he picks up this truly beautiful example of the bookmaker's art from the attractive jacket to the colorful cover, and explores page after page of illustrations and the accompanying stories of each tree. The former are all camera studies of leaves, flowers, fruits, and bark of the various species, together with a picture of an open grown tree both in summer and winter. These tree portraits provide the most striking feature of the book, especially those of the deciduous trees in winter.

In a few instances, such as the "cabbage" white pine, perhaps individuals were chosen primarily for their artistic value, rather than their "typicalness," but mostly the specimens photographed not only are typical but also highly artistic. The interesting written sketches of the various species include their chief marks of recognition, geographical range, their adaptability as ornamentals, how to transplant them, mention of some of their enemies, and stories of the author's experiences with these trees in boyhood and since.

When next printed, there are several errors in the Table of Contents which need correcting, such as *Fagus sylvatica* for American beech, *P. deltoidea* for cottonwood, and *Betulus* instead of *Betula*. On page 30, in discussing the wood of redcedar, the author states, "Despite its softness, it is remarkably resistant to rot." This gives the erroneous idea that soft woods are more prone to decay than are hard woods. Because of the high quality of most of the illustrations, surely the one on page 86 of a tuliptree flower past its prime and looking extremely bedraggled should be replaced by a picture showing this exquisite flower at the height of its beauty! On page 236, the illustration of branchlet and cones for white cedar (*Chamaecyparis thyoides*) appears to be from the Arborvitae (*Thuja occidentalis*) since the cones are oblong with thin scales.

One must be exceedingly bold to attempt to pick out the 59 "best loved trees of America." The reviewer has but few suggestions to offer by way of change. Gray birch is to many people (probably mostly foresters) nothing but a weed, and the much more "important" yellow birch could have been substituted! Only the black spruce has been included, while the giant of them all, the Sitka spruce, is omitted, to say nothing of the red spruce and the white spruce.

To summarize, here is a beautiful book on North American trees which will be treasured for its artistry, both in description and photographic portrayal.

WILLIAM M. HARLOW.

**Technical Reporting.**
By Joseph N. Ulman, Jr. 289 pp. Illus. Henry Holt and Co., New York. 1952. $4.75.

Edward Weeks, editor of the *Atlantic Monthly*, not long ago expressed the opinion that instruction in English in our secondary schools "has deteriorated to the point where the better-than-average graduates cannot write with accuracy, much less with skill." The same criticism has on occasion been made, not without cause, of graduates of institutions of higher learning, particularly of graduates of technical and professional schools.

In all fairness to the faculties of English departments where students of forestry receive most of their instruction in writing, this reviewer believes that those assigned to teach writing to student foresters do about the best job that can be expected considering the amount of time available for such instruction in a crowded curriculum and considering also the type of student they have to work with. This is not to say that forestry students are mentally less qualified than other classes of technical and professional students. Prof. Ulman states the problem in the very first sentence of this useful book.

"We may as well face the fact: the typical undergraduate regards the writing of reports as a dull and superfluous chore. Conse-

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quently, he has little desire for instruction in technical writing, and he approaches classes in this subject with a wary, bored resistance."

Prof. Ulman is a writer and engineer of long experience. As a teacher of technical writing at the Massachusetts Institute of Technology and an editor of reports of research projects at M.I.T., he provides a specific, practical guide to technical reporting. Although his book is directed primarily to the engineering professions, it contains much of value for workers in other sciences and professions. This reviewer especially commends it to the attenion of research foresters and teachers of forestry.

It is impossible in a brief review to describe in detail the contents of this excellent volume. But whether one is preparing a scientific record of research, a popularization of a technical subject for laymen, a simple office memorandum, or a job-application letter, he will find herein numerous definite recommendations and helpful examples.

The sections on style, grammar, and punctuation are splendid in their simplicity and fundamentals. For example, the three pages devoted to the *dangling modifier*, that confusing and illogical verb form that is one of the most frequent grammatical mistakes made by writers technical or otherwise, can be read with profit by all foresters. To the sorrow of this present reviewer, it must be admitted that some research foresters, and teachers of forestry as well, apparently do not know what a dangling modifier is, much less why it is wrong. (Do you, dear reader? If you don't, you are respectfully referred to pages 103-106 of this handbook.)

The author concludes with many helpful suggestions on the construction of tables, the preparation of graphs and curves, and other forms of visual presentation including photographic illustrations. An appendix contains numerous specimens of reporting.

Highly recommended.

HENRY CLEPPER.

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# Current Literature

*Compiled by* MARTHA MEELIG, *Librarian, The New York State College of Forestry*

*Range Management Section Compiled by* FRANCES FLICK, *Library, U. S. Department of Agriculture*

### General

*The Fraser Experimental Forest — Its Work and Aims.* 27 pp. Illus. Rocky Mountain Forest and Range Expt. Sta., Fort Collins, Colo. 1952. Station Paper No. 8. Processed.

*Ley Forestal y su Reglamento.* By E. G. Flores. 108 pp. Boletin Forestal, Aldama 701, Chihuahua, Chih., Mexico. 1951.

*The Manitou Experimental Forest—Its Work and Aims.* 23 pp. Illus. Rocky Mountain Forest and Range Expt. Sta., Fort Collins, Colo. 1952. Station Paper No. 7. Processed.

*Native Cottonwoods of Montana.* By W. H. White. pp. 33-39. Reprint from Proc. of Montana Acad. of Science. Vol. 9, 1951. Missoula.

*Second Half Century Growth.* The Yale School of Forestry. 16 pp. Illus.

*El Servicio Forestal de los Estados Unidos; Algunas de sus Practicas y Posible Aplicacion a las Condiciones Mexicanas.* By Gumersindo Borgo. 196 pp. Illus. Aldama 701, Chihuahua, Chic., Mexico. 1951.

*The Work of the California Forest and Range Experiment Station.* 12 pp. U. S. Forest Serv., Berkeley. 1952. Mimeog.

### Forest Economics

*Some Financial Aspects of Managing Forests for Pulpwood Production in Maine.* By A. G. Randall. 2 pp. Univ. of Maine Forestry Dept., Orono. 1952. Tech. Notes No. 12.

*Wood Is Wealth; Canada's Forest Economy 1938 to 1949.* 52 pp. Canada Dept. of Resources and Development, Ottawa. 1952. For. Bul. No. 105.

### Forest Management

*Cruising by Narrow Strips.* By H. A. Meyer. 3 pp. Pennsylvania State Forest School, State College. 1952. Research Paper No. 12. Mimeog.

### Forest Resources

*Forest and Forest Products Statistics, Canada.* 65 pp. Tables. Canada Dept. of Resources and Devel., Ottawa. 1952. Forestry Branch Bul. No. 106.

*1951 Pulpwood Production in the South.* By J. W. Cruikshank. 26 pp. Southeastern Forest Expt. Sta., Asheville, N. C. 1952. Forest Survey Release No. 38. Processed.

*The Vegetation of British Guiana: A Preliminary Review.* By D. B. Fanshawe. 96 pp. Illus. Imperial Forestry Inst., Univ. of Oxford, Oxford, Eng. Inst. Paper No. 29, 10 s.

### Logging and Milling

*The Handling and Transportation of Sawmill Waste for Pulpwood.* By G. E. Bell. 14 pp. Illus. Canada Dept. of Resources and Devel. Forest Products Lab. Div., Ottawa. 1952. Mimeog. 0-164.

*A Mill-Scale Log Rule.* By S. R. Gevorkiantz. 2 pp. Lake States Forest Expt. Sta., St. Paul 1, Minn. Tech. Notes No. 375.

*One Hundred Years of Lumbering in the State of Maine.* By Gregory Baker. 2 pp. Univ. of Maine Forestry Dept., Orono. 1952. Tech. Notes No. 11. Mimeog.

*Reducing Logging Damage.* By R. D. Cosens. 9 pp. California Forest and Range Expt. Sta., Berkeley. 1952. Forest Res. Notes No. 82. Processed.

### Pathology

*Pole Blight—What Is Known About It.* By Pole Blight Investigations Steering Committee. 17 pp. Northern Rocky Mountain Forest and Range Expt. Sta., Missoula, Mont. 1952. Misc. Pub. No. 4. Processed.

### Range Management

*Chemical Control of Big Sagebrush in Central Wyoming.* By N. A. Kissinger, A. C. Hull, and W. T. Vaughn. 15 pp. Illus. U. S. Forest Serv., Rocky Mountain Forest & Range Expt. Sta., Ft. Collins, Colo. Station Paper No. 9. June, 1952.

*Forage Grasses for Hay and Pasture: Uniform Nursery Testing of Forage Grasses Under Irrigation.* By J. H. Robertson. 3 Nos. Nevada Agric. Expt. Sta., Reno. Cir. No. 1-3. April-July 1952. Mimeog.

*Glossary of Range Terms.* By R. K. Miller and C. Conard. 3 Nos. New Agric. Bldg., Univ. of Wyoming, Laramie, Wyo. Range Mngt. Nos. 46, 49, 50. April-August 1952. Mimeog.

*Reseeding to Increase the Yield of Montana Range Lands.* By L. R. Short and E. J. Woolfolk. 26 pp. Ills. Supt. of Documents, U. S. Govt. Print. Off., Washington 25, D. C. U. S. Dept. Agric. Farmers' Bul. No. 1924. Revised. May 1952. 10 cents.

### Silviculture

*Disking to Regenerate Pulpwood Species.* By J. H. Stoeckeler. 1 p. Lake States Forest Expt. Sta., St. Paul 1, Minn. 1952. Tech. Notes No. 372. Mimeog.

*Forest Tree Planting in the Inland Empire.* By D. W. Lynch. 22 pp. Illus. Northern Rocky Mountain Forest and Range Expt. Sta., Missoula, Mont. 1952. Misc. Publ. No. 5. Processed.

*Labor Costs for Thinning Young Aspen.* By M. L. Heinselman. 1 p. Lakes States Forest Expt. Sta., St. Paul 1, Minn. 1952. Tech. Notes No. 374. Mimeog.

*Low Temperature Seed Storage for Western Conifers.* By P. O. Rudolf. 8 pp. Lake States Forest Expt. Sta., St. Paul 1, Minn. 1952. Misc. Publ. No. 20. Mimeog.

*Silvicultural Practices for Lodgepole Pine in Montana.* By R. K. LeBarron. 19 pp. Illus. Northern Rocky Mountain Forest and Range Expt. Sta., Missoula, Mont. 1952. Sta. Paper No. 33. Mimeog.

*Site-Index for Spruce-Fir Stands Based on Age at Breast Height.* By Peter Mount and William Gove. 3 pp. Univ. of Maine Forestry Dept., Orono. 1952. Tech. Notes No. 13. Mimeog.

*Soil Factors Influencing the Growth of Slash Pine Plantations in Northeast Florida.* By R. L. Barnes and C. W. Ralston. 11 pp. Illus. School of Forestry, Univ. of Florida, Gainesville. 1952. Res. Rept. No. 1. Processed.

*Soil Productivity for Southern Pines.* By T. S. Coile. 6 pp. Illus. Reprinted from "The Forest Farmer" Apr., May, 1952.

*A Vigor Classification for Mature Western White Pine Trees in the Inland Empire.* By C. A. Wellner. 3 pp. Northern Rocky Mountain Forest and Range Expt. Sta., Missoula, Mont. 1952. Res. Note No. 110. Mimeog.

### Wood Preservation

*The Kiln Sterilization of Lyctus-Infested Timber.* 4 pp. Great Britain Dept. of Scient. and Indus. Res. Forest Prod. Res. Lab., Princes Risborough. 1952. Leaflet No. 13 (Rev.).

### Wood Technology and Utilization

*The Effect of Exposure on Douglas Fir Cross-Arms.* By W. E. Wakefield. 16 pp. Canada Dept. of Resources and Devel. Div. of Forest Prod., Ottawa. 1952. Bul. No. 104.

*A Micro-Testing Technique for Wood.* By N. H. Kloot. pp. 126-143. Illus. Commonwealth Scient. and Indus. Res. Org., Div. of For. Products, Melbourne, Aust. 1952. Reprint No. 169 (fr. Aust. Jour of Applied Sci. Vol. 3, No. 2).

*91 Paper-Making Fibers; Revision of 1932 "Atlas of Paper-Making Fibers."* By C. H. Carpenter and Lawrence Leney. 152 pp. 382 photomicrographs. State Univ. of New York College of Forestry, Syracuse 10. 1952. Tech. Publ. No. 74. $2.00.

*Variability of Timber and the Derivation of Design Stresses.* By R. G. Pearson. pp. 144-155. Commonwealth Scient. and Indus. Res. Org., Div. of For. Products, Melbourne, Aust. 1952. Reprint No. 168 (fr. Aust. Jour. of Applied Sci. Vol. 3, No. 2).

# Society Affairs

## Officers and Members of the Council, 1952-1953

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RICHARD E. MCARDLE
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U. S. Department of Agriculture
Washington 25, D. C.

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Mills Building, 17th Street at Pennsylvania Avenue, N. W.
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Department of Forestry
University of Missouri
Columbia, Mo.

## Colleges and Universities in the United States Offering Instruction in Forestry

OCTOBER 1, 1952

### Accredited

**The following institutions are accredited for forestry instruction by the Council of the Society of American Foresters.**

Alabama Polytechnic Institute, Department of Forestry, Auburn, Ala.

University of California, School of Forestry, Berkeley 4, Calif.

Colorado A & M College, School of Forestry and Range Management, Fort Collins, Colo.

Duke University, School of Forestry, Durham, N. C.

University of Florida, School of Forestry, Gainesville, Fla.

University of Georgia, School of Forestry, Athens, Ga.

University of Idaho, School of Forestry, Moscow, Idaho.

Iowa State College, Department of Forestry, Ames, Iowa.

Louisiana State University, School of Forestry, Baton Rouge 3, La.

University of Maine, Department of Forestry, Orono, Maine.

University of Massachusetts, Department of Forestry and Wildlife Management, Amherst, Mass.

Michigan State College, Department of Forestry, East Lansing, Mich.

University of Michigan, School of Natural Resources, Ann Arbor, Mich.

University of Minnesota, School of Forestry, St. Paul 1, Minn.

University of Missouri, Department of Forestry, Columbia, Mo.

Montana State University, School of Forestry, Missoula, Mont.

State University of New York, College of Forestry, Syracuse, N. Y.

North Carolina State College, School of Forestry, Raleigh, N. C.

Oregon State College, School of Forestry, Corvallis, Oreg.

Pennsylvania State College, Department of Forestry, State College, Pa.

Purdue University, Department of Forestry, Lafayette, Ind.

Utah State Agricultural College, School of Forestry, Range and Wildlife Management, Logan, Utah.

University of Washington, College of Forestry, Seattle 5, Wash.

West Virginia University, Division of Forestry, Morgantown, W. Va.

Yale University, School of Forestry, New Haven 11, Conn.

### Not Accredited

**The following institutions offer professional and technical curricula in forestry, but do not meet the requirements for accreditation.**

Arkansas Agricultural and Mechanical College, Department of Forestry, College Heights, Ark.

Stephen F. Austin State College, Department of Forestry, Nacogdoches, Tex.

University of Connecticut, Department of Forestry and Wildlife Management, Storrs, Conn.

Harvard University, Harvard Forest, Petersham, Mass.

Louisiana Polytechnic Institute, Department of Forestry, Ruston, La.

Michigan College of Mining and Technology, Department of Forestry, Houghton, Mich.

University of New Hampshire, Department of Forestry, Durham, N. H.

Oklahoma Agricultural and Mechanical College, Department of Forestry, Stillwater, Okla.

University of the South, Forestry Department, Sewanee, Tenn.

Virginia Polytechnic Institute, Department of Biology, Blacksburg, Va.

State College of Washington, Department of Forestry and Range Management, Pullman, Wash.

### Introductory, Preforestry, and Specialized Courses

University of Arkansas, Department of Horticulture, Fayetteville, Ark.

Centenary College of Louisiana, Department of Biology, Shreveport, La.

Clemson Agricultural College, Department of Botany, Clemson, S. C.

Cornell University, Department of Conservation, Ithaca, N. Y.

Grand Rapids Junior College, Grand Rapids, Mich.

Idaho State College, Pocatello, Idaho.

University of Illinois, Department of Forestry, Urbana, Ill.

University of Kentucky, Department of Horticulture, Lexington, Ky.

Lassen Junior College, Division of Vocational Forestry and Lumbering, Susanville, Calif.

Mississippi State College, Department of Forestry, State College, Miss.

John Muir College, Pasadena 3, Calif.

North Dakota Agricultural College, Department of Horticulture and Forestry, Fargo, N. Dak.

North Dakota School of Forestry, Bottineau, N. Dak.

Northwestern State College, Agriculture Department, Natchitoches, La.

Ohio State University, Department of Horticulture and Forestry, Columbus 10, Ohio.

Paul Smith's College, Forestry Department, Paul Smiths, N. Y.

Rutgers University, Department of Forestry, New Brunswick, N. J.

Rutland Junior College, Rutland, Vt.

University of Tennessee, Department of Horticulture and Forestry, Knoxville 16, Tenn.

Texas A & M College, Department of Range and Forestry, College Station, Tex.

University of Vermont, College of Agriculture, Burlington, Vt.

University of Virginia, School of Forestry, Charlottesville, Va.

University of Wisconsin, College of Agriculture, Madison, Wis.

### Ranger Schools

State Forest Ranger School of the University of Florida, Lake City, Fla.

State Ranger School of State University College of Forestry, Wanakena, N. Y.

## Membership Program Initiated

On October 1, the 1952-1953 program to increase membership was initiated. Memoranda have gone forward from the Society office to Section representatives at institutions accredited for professional forestry instruction requesting their continued support in obtaining Student members, and to Sections and their membership committees requesting their cooperation in getting nonmembers to apply for membership and considering the advancement of eligible Juniors to the Member grade.

Individual Society members can cooperate by recommending the names of eligible candidates for initial election or advancement, to Sections and Chapters or to the Society office. (A directory of Section officers appears in the October JOURNAL, pp. 788-789.) Nonmembers, or Juniors eligible for regular or automatic advancement, need not wait upon an invitation from a Section to apply. An eligible candidate may initiate an application on his own behalf. Full information on membership qualifications for each grade may be obtained from the Sections. Briefly they are as follows.

*Student Member.* Junior and senior students enrolled in approved curricula at institutions accredited for professional forestry instruction, and graduate students not eligible for Junior membership.

*Junior Member, Class A.* Professionally trained foresters who are graduates of approved curricula in accredited forestry schools. Affiliate members who have had equivalent training may apply for advancement to the Junior grade, Class B.

*Affiliate Member, Class A.* Graduates of nonaccredited forestry schools who have completed curricula containing the required basic forestry courses.

*Affiliate Member, Class B.* Men with six years of qualifying forestry experience alone, or with a combination of

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experience and collegiate training in forestry totaling at least six years.

*Associate Member, Class A.* Scientists in fields closely related to forestry.

*Associate Member, Class B.* Persons, not foresters or scientists in related field, who have made outstanding contributions to forestry.

*Member (regular advancement).* Junior Members who have had at least three years' experience in forestry subsequent to the date they met the requirements for Junior Membership. (Generally this means three years forestry experience subsequent to the date that forestry degree was received.)

*Member (automatic advancement).* Junior Members, presently engaged in forestry work, who had been in the Junior grade at least six years.

## Candidates for Membership

Candidates for admission, advancement or reinstatement whose membership applications were received in the Society office during the month of September are listed below.

Action regarding the eligibility of these candidates will be taken by the Council as of December 1, 1952. Any communications from voting members relating to the membership eligibility of any of these candidates should be received in the Society office prior to that date.

**Allegheny Section**

*Junior Grade*

Helmick, H. E., State Forester, W. Va. Cons. Comm., Charleston, W. Va.; W. Va. Univ., B.S.F., 1941.

Jensen, J. T., Jr., Asplundh Tree Expert Co., Jenkintown, Pa.; Pa. State, B.S.F., 1950.

Mortensen, G. A., Asst. Forester, Armstrong Forest Co., Johnsonburg, Pa.; Pa. State, B.S.F., 1950.

Thorpe, R. R., Farm Forester, Pa. Dept. of Forests and Waters, Norristown, Pa.; Pa. State, B.S.F., 1952.

*Member Grade*

Stasiek, H. E., Asst. Dist. Forester, Md. Dept. of Forests and Waters, Bel Air, Md.; Univ. of Mich., B.S.F., 1947. (Junior, 1948).

**Appalachian Section**

*Junior Grade*

Kiser, B. R., Asst. Dist. Forester, N. C. Forest Service, Asheville, N. C.; N. C. State, B.S.F., 1949.

Leitch, M., Forester, Clinchfield Coal Corp., Dante, Va. Reinstatement.

**Central Rocky Mountain Section**

*Affiliate Grade*

Winkley, D. F., Lt., U. S. Army, Rapid City A.F.B., Weaver, S. Dak.; Univ. of N. H., B. S., (Forestry), 1952.

**Central States Section**

*Junior Grade*

Quinney, D. N., Research Forester, Lake States Forest Exp. Sta., White Cloud, Mich.; Pa. State, B.S.F., 1950.

Von Ohlsen, E. F., Asst. Forester Baker Wood Preserving Co., McArthur, Ohio; State Univ. of N. Y., B.S.F., 1951.

*Student Members Proposed for Advancement*

MICHIGAN STATE COLLEGE
Sterling, H. D.

PURDUE UNIVERSITY
Gurley, P. A.
Veregge, E. J.

*Member Grade*

Cunningham, G. R., Asst. Ext. Forester, Univ. of Ill. Ext. Service, Urbana, Ill.; Mich. State, B.S.F., 1948; Pa. State, M.S.F., 1950. (Junior, 1949).

Hutchison, O. K., Forest Economist, C. S. Forest Exp. Sta., Columbus, Ohio; Oregon State, B.S.F., 1939. (Junior, 1947).

Kent, B. F., Farm Forester, State of Ohio, Chillicothe, Ohio; Univ. of Mich., B.S.F., 1942. (Junior, 1950).

*Affiliate Grade*

Dodd, A. B., Field Engr., U. S. Dept. of Interior, Arlington, Va.; Univ. of Conn., B.S., (Forestry), 1952.

## S. H. Marsh (1886-1952)

Seward Hankins Marsh, who had retired from the U. S. Forest Service last year, died in Arlington, Va. on September 16. He was born in Pawnee City, Nebr., on March 28, 1886.

A graduate of Berea College in 1909, he received the M.F. degree in 1911 from Yale, and entered the U. S. Forest Service that year.

After working for six years on national forest acquisition in the southern Appalachians, he was appointed supervisor of the Shenandoah National Forest. Promoted in 1927 to the new position of assistant district (now regional) forester in charge of states relations in the Washington office, he was later given the title of senior district forest inspector.

Mr. Marsh resigned from the Forest Service in 1929 to enter private business, but within a year became supervisor of state parks in Virginia, and three years later returned to the Forest Service.

From 1934 until his retirement last year, Mr. Marsh helped develop fire prevention and suppression organizations in Virginia, Maryland, West Virginia, and Kentucky as a specialist in the Division of State and Private Forestry of the Forest Service's Eastern Region (7).

On Mr. Marsh's retirement, in comment on his long and loyal service, the Secretary of Agriculture wrote him, ". . . much progress has been made in forestry, and I know you are proud of the important and constructive part you had in it."

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**Columbia River Section**

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Friese, H. A., Camp Clerk, Weyerhaeuser Tbr. Co., Sutherlin, Oreg.; Oregon State, B.S.F., 1949.

Reynolds, C. E., Consulting Forester, 7715 S. E. 32nd Ave., Portland, Oreg.; State Univ. of N. Y., B.S.F., 1933; M.F., 1935. Reinstatement.

*Student Members Proposed for Advancement*

OREGON STATE COLLEGE

Thomas, V. D.

*Member Grade*

Anderson, K. M., Fire Warden, Asst. Surveyor, Cascades Plywood Corp., Lebanon, Oreg.; Iowa State, B.S.F., 1942. (Junior, 1946).

Bradshaw, G. E., Inspt., Booth-Kelly Lbr. Co., Springfield, Oreg.; Calif. A. & M., B.S.F., 1937. (Junior, 1947).

Wine, H. R., Forester, U. S. Indian Service, Klamath Agency, Oreg.; Oregon State, B.S.F., 1932. (Junior, 1946).

**Gulf States Section**

*Junior Grade*

*Student Members Proposed for Advancement*

LOUISIANA STATE UNIVERSITY

Wall, S. R.

*Member Grade*

Schoenaller, W. E., Tbr. Mgmt., U.S.F.S., Winnfield, La.; Univ. of Mich., B.S.F., 1938. (Junior, 1945).

*Affiliate Grade*

Waller, R. E., Dist. Forester, Lutcher and Moore Lbr. Co., Orange, Texas; Stephen F. Austin State College, B.S., (Forestry), 1948.

**Kentucky-Tennessee Section**

*Junior Grade*

Gouffon, C. L., Asst. Chief, Forest Dev. Br., T.V.A., Norris, Tenn.; Univ. of Tenn., B.S.C.E., 1932. (Associate, 1943).

*Affiliate Grade*

Beavers, J. T., Asst. Dist. Forester, Tenn. Cons. Dept., Harriman, Tenn.; Univ. of the South, B.S., (Forestry), 1948.

**New England Section**

*Junior Grade*

Quick, H. F., Asst. Prof., Game Mgmt., Univ. of Me., Orono, Me.; Pa. State, B.S.F., 1937; Univ. of Mich., M.S.F., 1940.

Thurston, H. F., Forester, Int. Logging Corp., Rumford, Me.; Univ. of Me., B.S.F., 1951.

*Affiliate Grade*

Bielefield, R., Miner St., R.F.D. #1, Middletown, Conn.; Univ. of Conn., B.S., (Forestry), 1952.

Mitchell, C. B., 208 Tolbert St., Berlin, N. H.; Univ. of N. H., B.S., (Forestry), 1952.

Olsen, J., Rgr., Conn. Park and Forest Comm., Pleasant Valley, Conn.; Univ. of Conn., B.S., (Forestry), 1951.

Sposta, J. W., Asst. to Dist. Forest Rgr., State of Conn., Forestry Div., Hartford, Conn.; Univ. of Conn., B.S., (Forestry), 1951.

Terrill, R. P., Fish and Game Tech., N. H. Fish and Game Dept., Concord, N. H.; Univ. of Conn., B.S., (Forestry), 1952.

Webb, R. B., Camp Foreman, Brown Co., Berlin, N. H.; Univ. of N. H., B. S., (Forestry), 1950.

**New York Section**

*Junior Grade*

*Student Members Proposed for Advancement*

STATE UNIVERSITY OF NEW YORK

Roithmayr, C. M.

*Member Grade*

Leney, L., Instructor, State Univ. of New York, Syracuse, N. Y.; State Univ. of N. Y., B.S.F., 1942. (Junior, 1947).

Olcott, F. W., Cons. Investigator, N. Y. State Cons. Dept., Westport, N. Y.; State Univ. of N. Y., B.S.F., 1946. (Junior, 1946).

Silversides, C. R., Wood Dept., Abitibi Power and Paper Co., Toronto, Can.; Univ. of Toronto, B.S., (Forestry), 1939. (Junior, 1946).

Wilcox, H. E., Research Assoc., State Univ. of N. Y., Syracuse, N. Y.; Univ. of Calif., B.S.F., 1938; State Univ. of N. Y., M.S., 1940. (Junior, 1946).

**Northern California Section**

*Junior Grade*

Halsey, D. G., Forestry Aide, Bureau of Land Mgmt., San Francisco, Calif.; Univ. of Calif., B.S.F., 1952.

Kuch, H. K., Bullbuck, Sugar Pine Lbr. Co., Hoopa, Calif.; Univ. of Wash., B.S.F., 1939.

McCollum, L. H., Asst. to Forester, Pac. Lbr. Co., Scotia, Calif.; Univ. of Calif., B.S.F., 1940.

*Member Grade*

Frazier, W. T., Asst. Forest Tech., Jackson State Forest, Mendocino, Calif.; Univ. of Calif., B.S.F., 1942. (Junior, 1946).

**Northern Rocky Mountain Section**

*Junior Grade*

*Student Members Proposed for Advancement*

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### Ozark Section

*Junior Grade*

Hafner, K. F., Asst. Dist. Forester, Mo. Cons. Comm., Ellington, Mo.; Univ. of Mo., B.S.F., 1950.

Stevens, J. E., Stevens Forestry Service, 701 E. Fourth, El Dorado, Ark. Reinstatement.

### Puget Sound Section

*Junior Grade*

Nelson, W. A., Forester, Tieton Rgr. Sta., Naches, Wash.; Univ. of Minn., B.S.F., 1950.

*Member Grade*

Colwell, D. E., Logging Supt., Cascade Lbr. Co., Yakima, Wash.; Univ. of Wash., B.S.F., 1946. (Junior, 1947).

Peavey, R. J., Land Agent, Weyerhaeuser Tbr. Co., Centralia, Wash.; Univ. of Minn., B.S.F., 1941. (Junior, 1946).

Sieber, D. H., Transitman, c/o Weyerhaeuser Tbr. Co., Chehalis, Wash.; Univ. of Wash., B.S.F., 1949. (Junior, 1949).

*Affiliate Grade*

Grove-White, C. D., Consulting Forester, 96 Leigh Rd., North Kamloops, B.C., Canada; State College of Wash., B.S., (Forestry), 1942.

Munro, D. W., Forester, B.C. Forest Service, Nelson, B.C., Canada; Univ. of B.C., B.S. (Forestry), 1951.

### Southeastern Section

*Junior Grade*

Posey, H. G., Asst. Prof. of Forestry, A.P.I., Auburn, Ala.; N. C. State, B.S.F., 1950; M.S.F., 1950.

*Member Grade*

Nieland, L. T., Ext. Forester, Agric. Ext. Service, Gainesville, Fla.; Univ. of Fla. (Agric.), 2 yrs. (Aff., 1941, Junior, 1947).

Schoyer, E. A., Asst. Dist. Forester, Fla. Forest Service, Lakeland, Fla.; Mich. State, B.S.F., 1933. Reinstatement.

*Affiliate Grade*

Levings, A. S., Logging Supv., St. Regis Paper Co., Lake City, Fla.

### Southern California Section

*Member Grade*

Sischo, P. C., Forest Tech., Calif. Div. of Forestry, Riverside, Calif.; Univ. of Minn., B.S.F., 1915. (Junior, 1946).

### Southwestern Section

*Member Grade*

Bond, W. F., Asst. Supv., U.S.F.S., Santa Fe, N. Mex.; Bates College, B.S., 1921; Yale, M.F., 1924. Reinstatement.

Raide, T. E., Forester, U. S. Indian Service, Whiteriver, Ariz.; Univ. of Idaho, B.S.F., 1935. (Junior, 1946).

### Upper Mississippi Valley Section

*Junior Grade*

French, D. W., Instructor, Dept. of Plant Path., Univ. of Minn., St. Paul, Minn.; Univ. of Minn., B.S.F., 1943; M.S., 1949; Ph.D., 1952.

Holt, B. P., Jr., Forester, Red Lake Indian Agency, Red Lake, Minn.; Colo. A & M., B.S.F., 1951.

*Affiliate Grade*

Beck, J. D., Asst. Dist. Forester, Minn. and Ontario Paper Co., International Falls, Minn.; Univ. of Minn., (2 yrs.).

Smith, W. R., Engr. Aide, U.S.F.S., Ely, Minn.; Mich. College of Mining and Tech., B.S., (Forestry), 1952.

### Washington Section

*Junior Grade*

Welsh, J. F., 2549 N. Granada St., Arlington, Va.; Duke Univ., B.S., (Forestry), 1951; M.F., 1952.

*Member Grade*

Burks, G. F., Asst. Chief, Div. of Forest Economics, U.S.F.S., Washington, D. C.; Univ. of Calif., B.S.F., 1933. Reinstatement.

*Affiliate Grade*

Sprague, R. J., Field Engr., U. S. Geological Survey, Arlington, Va.; Univ. of N. H., B. S., (Forestry), 1952.

*Associate Grade*

McCutchan, R. L., Chief, Pole Inspt., and Wood Preservation Section, Rural Electrification Adm., Washington, D. C.; Austin College, B.A., 1925.

Wedgewood, H. E., Ass't. Chief, Lbr. Production, Dept. of Commerce, Washington, D. C.

### Wisconsin-Upper Michigan Section

*Junior Grade*

Pierce, R. S., Soils Dept., Univ. of Wis., Madison, Wis.; Univ. of Mich., B.S.F., 1949; Univ. of Wis., M.S., 1952.

*Member Grade*

Racey, C. H., Forest Supv., Great Lakes Indian Agency, Ashland, Wis.; Univ. of Minn., B.S.F., 1923. (Junior, 1946).

*Affiliate Grade*

Jarvey, C. C., Asst. Dist. Forester, Dept. of Cons., Newberry, Mich.; Mich. College of Mining and Tech., B.S., (Forestry), 1949.

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## Natural Resources Council Elects Officers at Annual Meeting

The annual meeting of the Natural Resources Council of America was held in Waycross, Ga., October 9-11. The Council, with which the Society of American Foresters is affiliated, has a membership of thirty-four national conservation, scientific and natural resource organizations.

Officers elected for the current year are as follows:

Chairman—William Voight, Jr. of the Izaak Walton League, Chicago.

Vice Chairman—Samuel H. Ordway of the Conservation Foundation, New York City.

Secretary—C. R. Gutermuth of the Wildlife Management Institute, Washington, D. C.

Treasurer—Harry E. Radcliffe of the American Nature Association, Washington, D. C.


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# Forestry News

### Association of State Foresters Selects New Officers

The Association of State Foresters, at its annual meeting held in Colorado Springs, September 16 to 18, selected the following executive committee to serve for the coming year:

President—George W. Dean, Charlottesville, Va., State Forester, Department of Conservation and Development.

Vice President—Bernard L. Orell, Olympia, Wash., Supervisor of Forestry, Department of Conservation and Development.

Secretary-Treasurer—Eric G. Jacobson, Providence, R. I., Chief Forester, Department of Agriculture and Forestry.

Members—Fred H. Lang, Little Rock, Ark., retiring president, Director, Division of Forestry and Parks, Resources and Development Commission; George O. White, Jefferson City, Mo., State Forester, Conservation Commission.

### Bishop Succeeded by Stewart As T.F.A. Executive Secretary

L. L. Bishop, long identified with forestry in the South, has resigned as executive secretary of the Texas Forestry Association, a position which he has held since November 1949. He plans to enter the forest consultant field in Houston, where he will be associated also with his son in the Bishop Realty Company.

Bishop has served as forest supervisor of the national forests in Florida, Alabama, and Texas, and for nine years as assistant regional forester of Region 8. For two years he headed the Branch of Forest Products, Forestry Division, Natural Resources Section, on General MacArthur's staff in Japan.

Bruce F. Stewart, succeeding executive secretary of the association, has for the past four years served as forester and manager of the Independent Pulpwood Producers, Inc., Cleveland, Tex. Prior to this he had worked as district forester with the Texas Forest Service, where he pioneered the use of aircraft in fire detection for that organization.

Stewart served for five and a half years in the Army during World War II and remains active in reserve work, holding a commission as major in the O.R.C. He is a graduate of the University of Georgia School of Forestry, 1939.

### John B. Veach Named Chairman, Lumber Survey Committee

John B. Veach, president of the National Lumber Manufacturers Association, has been appointed chairman of the newly revamped Lumber Survey Committee. This industry-sponsored committee submits a quarterly report to the Secretary of Commerce covering a national survey of the current status in lumber supply and demand.

The report includes statistics on lumber production, shipments, orders, stocks, exports and imports, and estimated consumption. Also given is information on the important lumber-consuming industries—building and construction, boxes and crating, hardwood flooring, furniture, and railroads.

First issued in 1931, the report reflects the opinions of leaders in the lumber industry on current conditions as it is based largely on their answers to queries sent out regularly by the committee.

Other members of the committee are: Harold E. Holman, deputy director, Lumber and Wood Products Division, National Production Authority, secretary of the committee; Edward W. Conklin (president, National-American Wholesale Lumber Association) Mixer and Company, Buffalo, N. Y.; Clyde A. Fulton (president, National Retail Lumber Dealers Association) Colburn, Fulton Lumber Company, Charlotte, Mich. Arthur S. Horner (president, Associated General Contractors of America, Inc.) A. S. Horner Construction Company, Denver, Colo.; Thomas S. Holden, president, F. W. Dodge Corporation, New York; Mathias W. Niewenhous, forest products advisor, Office of Programs and Requirements, Materials Division, Defense Production Administration; and George R. Birkelund, president, Baker Fentress and Company, Chicago, Ill.

### Southern Forestry Conference Scheduled for March 5-6

The Forest Farmers Association of Valdosta, Ga. announces its 1953 Southern Forestry Conference to be held in Pensacola, Fla., March 5-6.

Theme of the conference will be "Lumber's Increasing Responsibility in the Nation's Economy," and special note will be made of the lumber industry's contribution to forest development in the South and the industry's future role in this field.

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### Survey Shows Kentucky Forests More Than 90 Percent Hardwood

Kentucky has 24.7 billion board feet of saw timber, more than 90 percent of which is in hardwood species, according to Forest Survey Release No. 13, *Forest Statistics of Kentucky*, recently published.

The report was compiled by the Central States Forest Experiment Station, Columbus, Ohio. Cooperating in the survey were the Tennessee Valley Authority Division of Forestry Relations, the Kentucky Department of Conservation, and the University of Kentucky.

The survey points out that Kentucky forests are growing about 104 board feet per acre each year as compared to an annual cut of about 64 board feet per acre. While the net growth of Kentucky forests is exceeding annual cut, the excess growth is chiefly in small and low quality trees. The cutting of high quality hardwood timber exceeds growth of high quality timber by nearly 50 percent.

The total sawlog volume shown in the present survey is about twice the amount estimated in the 1945 reappraisal report. This difference is attributed to the greater accuracy of the recent survey rather than to changes in the forest during the past few years.

The survey included an analysis of the forest situation and tables on forest area, timber volumes, timber growth, and the amount of timber cut. Kentucky's commercial forest land, according to the report, covers 11.4 million acres, or 45 percent of Kentucky's total land area. These lands now support an average of 2,154 board feet of saw timber per acre.

### Brush Eradication on Clemons Tree Farm

Experimental area brush-spraying is being carried on by Weyerhaeuser Timber Company, according to Robert M. Ramstad, resident forester at the firm's Clemons tree farm near Elma, Wash.

"If we are able to control the brush in the 5 and 10-acre plots we are spraying, reforestation will be substantially easier," reports Ramstad. "Thickly growing vine maple, big-leaf maple, alder, salmon berry, thimble berry, salal, Oregon grape, and other plant varieties have made it very difficult to restock certain areas with Douglas-fir."

Weed killers being used are of both new and old formulation, and while proven through ground application, some are new to aerial spray work.

### Porcupine Damage to Trees Serious in Northwest

Regional Forester J. Herbert Stone reports that porcupine damage to trees in the Northwest is reaching serious proportions. To combat the continued increase of the rodent, with its resulting damage to trees in the national forests, Stone has called upon hunters to practice their marksmanship on these animals. They are not protected by law and may be killed at any season.

The marked increase in the species is attributed to heavy reduction in the fisher population, chief enemy of the porcupine, which is trapped for its valuable fur. Records show that a single porcupine can and often does damage or kill as many as 100 trees during a winter.

### Over 36 Million Seedlings Purchased by Industry in South

Over 36½ million seedlings (slightly more than 1/5 of the total production) were purchased by the lumber industry during the past 1951-52 planting season. Additionally, 1 2/3 million seedlings secured from other sources including company nurseries were planted by lumber manufacturers. These seedlings were planted on nearly 41,000 acres of company-owned lands and over one million seedlings were given to farmers.

According to reports received from 210 lumber manufacturers, 87 of these companies anticipate purchasing over 39½ million seedlings during this coming fall and winter planting season. Manufacturers subscribing to the Southern Pine Association accounted for 58% of the seedlings planted on company lands and 64% of those distributed to adjoining landowners during the past year.

### Youngberg Joins Oregon State College Staff

Dr. C. T. Youngberg, who has been on the research staff of Weyerhaeuser Timber Company since 1951, has been appointed forest soils scientist to undertake a long range soil management program launched by the agricultural experiment station and the school of forestry at Oregon State College.

Youngberg received his bachelor's degree in botany from Wheaton College in 1941, after which he had a four-year tour of duty with the Air Force in World War II. He received his Master of Forestry degree from the University of Michigan in 1947 and his doctorate in forest soils from the University of Wisconsin in 1951.

### Hammond Lumber Co. Expands Its Forestry Program

As a major part of its policy to operate its lands on a sustained yield basis, the Hammond Lumber Company of California has inaugurated a large-scale artificial reforestation program and expansion of its fire protection system.

The program will cost around a quarter of a million dollars to install and maintain, and will cover the protection of approximately 48,000 acres of cut-over land located in the Little River and Maple Creek basins and the reforestation of some 3,000 acres in the Big Lagoon area which was heavily burned in the Maple Creek forest fire of 1945.

Waldron Hyatt, general manager of Hammond's redwood division, announced that once the program is well under way, the company will apply to the California Redwood Association for a tree farm certificate covering Big Lagoon and Little River—nearly 93,000 acres of virgin and cut-over lands stretching from Orick to southeast of Crannell.

The protection system will take five years to complete and will include the construction of 178 miles of roads and trails, 12½ miles of snag-free fire breaks along key ridges, development of water supplies, and three lookout points.

In the burned-over area, 2,145 acres will be seeded with redwood and Douglas-fir and 785 acres will be planted with two-year-old trees.

Hammond already operates two tree farms totalling 21,221 acres near Carlotta on the Van Duzen river and at Camp Grant near South Fork.

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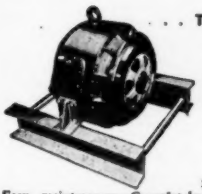

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## Gordon Day Joins Timber Management Group

Dr. Gordon M. Day has resigned as chairman of the Forestry Department of Rutgers University, and joined the staff of New England Forest Industries, Inc., as associate forester, in Concord, N. H., where he will be in charge of administration and research.

He was graduated from New York State Ranger School in 1933, and later worked for the Vermont Forest Service. He obtained his B.S. in 1938, and his M.F. in 1939, in forest soils, both from New York State College of Forestry. Dr. Day worked with the Connecticut Experiment Station and in the Northeastern Forest Experiment Station of the U. S. Forest Service and the Green Mountain National Forest, until he joined the staff of Rutgers University in 1941.

He received his Ph.D. from Rutgers in 1949, in soil microbiology, studying under Dr. S. A. Waksman, the discoverer of streptomycin, and minored in plant physiology.

## Roy Lister Robinson (1883-1952)

Lord Robinson, chairman of Great Britain's Forestry Commission, died September 5 in Ottawa, Canada. He was 69 years of age. He had been an Honorary Member of the Society of American Foresters since 1940.

Born in Perth, Western Australia on March 8, 1883, he received the B.S. degree (Adelaide) in 1902 and the B.A. degree (Oxon) in 1908. From 1905 to 1908 he was a Rhodes Scholar.

He started his forestry career as assistant inspector in 1909, became inspector in 1910, and superintending inspector in 1912. From 1914 to 1918, Lord Robinson served with the Ministries of Munitions and Agriculture. Following World War I, he was appointed Technical Commissioner of Forestry in 1919.

Since 1932 he had been Chairman of the Forestry Commission of Great Britain, the first professionally trained forester to serve in this capacity.

## Louisiana Forestry Association Names New President

It has been announced by James H. Kitchens, Jr., executive secretary, that election of new officers and executive committee has launched the Louisiana Forestry Association on the most ambitious program in its history. Chosen to lead the group for the coming year is R. H. Crosby, Jr., of DeRidder. Charles H. Jeter, Shreveport, outgoing president, has served for two years.

Kitchens reports that the goal of forest-minded men in Louisiana is complete reforestation in 15 years, and that most of the hurdles before that goal is reached lie in the fields of education and legislation. For this reason the association will launch an extensive educational campaign during the next two years.

## Receives Graduate Fellowship

James E. Moak of McComb, Mississippi has been selected to receive the first Westervelt Forestry Fellowship for graduate study at Alabama Polytechnic Institute.

The fellowship consists of a $2,000 gift made available by the Gulf States Paper Corporation of Tuscaloosa, honoring its founder, H. E. Westervelt. It is offered to encourage students qualified for graduate study in forestry to pursue work toward the master's degree. Selection is made on the basis of scholarship, character, and all around ability of a student to undertake graduate study.

Moak has had eight years experience with the U. S. Forest Service and three years in the U. S. Army Air Force. He attended Mississippi State College in 1949 and 1950, transferred to the University of Florida where he received his B.S. degree in forestry last June. He has entered A.P.I. graduate school in forestry and will work on a problem of interest to the pulp and paper industry in addition to his academic studies.

He is a member of the honor fraternities XI Sigma Pi and Phi Kappa Phi.


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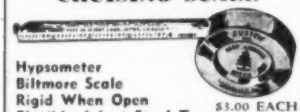

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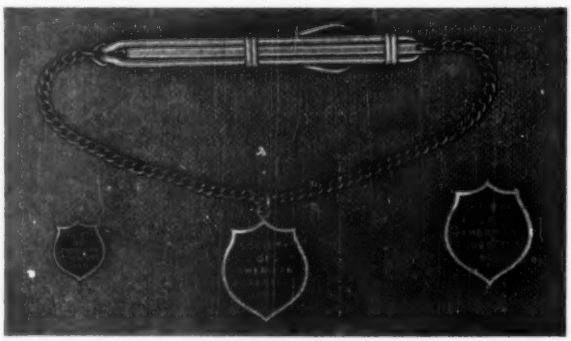

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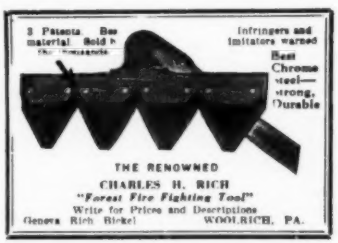

### No SS U. S. Without Wood

Building of the mammoth new superliner, SS United States, would not have been possible without the use of wood. So says the United States Lines, owner of the pride of the U. S. maritime fleet.

More wood was used in the construction of the SS United States—an all-metal ship—than is normally used in the construction of large all-wood vessels. In fact, the SS U. S. is the world's greatest "wooden" ship, for its birth required enough lumber, poles, and blocks to stretch out 200 miles if placed end to end. The nearly 3 million board feet of lumber and wood that went into its construction would build at least 12 ships the size of the "Constitution," or three ocean-going ships 300 feet in length.

United States Lines figures on the amount of wood used to build the superliner reveal enough pine boards—850,000 feet—to build a 2,000-ton wooden ship 300 feet long. The shipyard's pattern makers needed an additional 187,000 board feet of wood; another 150,000 board feet went into protective coverings, packing, and shipping cases. For purposes such as braces, ladders, ribband, and stage boards, 2,082,000 board feet of Douglas-fir and southern pine were used.

Just the supports for the scaffolding erected during the construction of the ship took $6\frac{1}{2}$ miles of pine poles—some of which were as much as 95 feet high. Staging utilized 240,600 board feet of Douglas-fir poles.

Enough oak blocks went into cribbing and shoring the liner to build more than 14 two-story, six-room houses. Oak timbers used as keel track and cribbing amounted to 222,000 board feet. There were 115,700 board feet of southern pine poles used in shoring; an additional 66,900 board feet of southern pine lumber for blocking and shoring.

### Marshall Bibliography Available

A bibliography of the published works of Robert Marshall, deceased, well known forester and writer, is available to interested persons in the 1951 autumn issue of *The Living Wilderness*. Copies may be secured by writing The Wilderness Society, 1840 Mintwood Place, N. W., Washington 9, D. C.

### Idaho Continues Use of Radioactive Isotopes

Research in forest tree physiology using radioactive isotopes will be carried on another year at the University of Idaho Forest, Wildlife, and Range Experiment Station under an agreement with the Atomic Energy Commission. A grant of approximately $9,000 from the commission to finance the second year of the research has been accepted by the university regents.

Under this grant, Dr. W. K. Ferrell, forest soils technologist, and Dr. E. E. Hubert, research forest pathologist, are studying the translocation of nutritional elements, particularly calcium and phosphorus, in Idaho white pine. Studies are being made on large trees, both diseased and healthy, at the Deception Creek branch of the Northern Rocky Mountain Forest and Range Experiment Station near Coeur d'Alene in cooperation with the U. S. Forest Service, and with potted seedlings in the forestry greenhouse at the university.

Principal objective of this research is to determine whether pole blight is a nutritional problem stemming from defective translocation within the trees.

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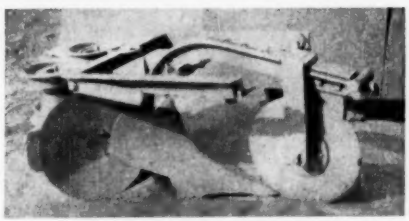

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### Long Term Forest Loans Made in South

The Forest Farmers Association of Valdosta, Ga. has determined by a recent survey that at least $700,000 in long term forest loans have been negotiated so far this year by private firms in the South.

All of the loans to date have been made by the Roberts Insurance Agency, Inc. of Valdosta, which inaugurated its program in April of this year. One other firm, Southeastern Foresters, Forest Consultants, 234 Sixth Avenue, N., Jacksonville Beach, Fla., is also prepared to do business in this field.

### Xi Sigma Pi Elects Officers

Xi Sigma Pi, national forestry honorary fraternity, has announced the selection of officers to serve for the next two academic years, as follows: Forester, Lenthall Wyman; Associate Forester, James S. Bethel; Secretary-Fiscal Agent, William D. Miller. All three are members of the faculty of the School of Forestry, North Carolina State College, Raleigh.

Burton, Inc., of Richmond, Ind., has announced a new chain saw—the Sawette—which will cut trees and other growth 6 inches in diameter. The Sawette enables the operator to cut level with ground while in upright standing position. Features include: 2 horsepower engine, concentric bowl float feed carburetor, 1 quart gas tank, 12 inch tempered, spring steel blade bar, ½-inch pitch chisel tooth, 32-inch saw chain. The weight is 26 lbs.

### Weyerhaeuser Establishes $100,000 Memorial Fund

The Weyerhaeuser Timber Foundation has established a $100,000 memorial fund at Yale University in honor of the late pioneer forester, Charles S. Chapman. The fund will be used for the advancement of industrial forestry through grants for fellowships, research, and other activities that may be designated by the dean of the School of Forestry. Chapman was a forestry graduate of Yale and was active in the early days of organized forestry in the West.

### Eleven Million Aid for Fish and Wildlife

Federal excise taxes on sporting arms and ammunition during the past fiscal year will make available for allocation to the states under the Pittman-Robertson law $8,822,093 for wildlife conservation work. A similar tax on sport fishing tackle will provide $2,508,527 under the Dingell-Johnson law for aid to state fisheries programs.


ANNOUNCING
TWO NEW
Powerful, Lightweight
CHAIN SAWS

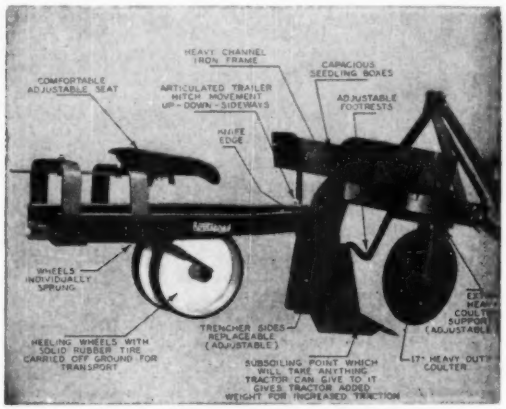
WOODBOSS—P.M.
ROCKET
3½ H.P.—24½ lbs.
without bar and chain

WOODBOSS—P.M.
TORPEDO
5 H.P.—36 lbs.
without bar and chain

For both heavy and light duty, users are finding these two new saws outstanding for power and dependability. Free of gadgets and delicate parts, they're easy starting, easy running, steady producers. Write for complete information and prices.

LIVE DEALERS WANTED

WOODBOSS, INC.
United States Representative
1800 S. E. Union Avenue • Portland 14, Oregon
Manufactured by POWER MACHINERY, LTD.
148 E. Third Ave. • Vancouver, British Columbia



HEAVY CHANNEL IRON FRAME
COMFORTABLE ADJUSTABLE SEAT
ARTICULATED TRAILER HITCH MOVEMENT UP-DOWN-SIDEWAYS
CAPACIOUS SEEDLING BOXES
ADJUSTABLE FOOTRESTS
KNIFE EDGE
WHEELS INDIVIDUALLY SPRUNG
TRENCHER SIDES REPLACEABLE (ADJUSTABLE)
HEELING WHEELS WITH SOLID RUBBER TIRE CARRIED OFF GROUND FOR TRANSPORT
SUBSOILING POINT WHICH WILL TAKE ANYTHING TRACTOR CAN GIVE TO IT GIVES TRACTOR ADDED WEIGHT FOR INCREASED TRACTION
17" HEAVY DUTY COULTER


ROOTSPRED TREE PLANTER

1. Adapted to all tractors with 3-point lift: (Ford, Ferguson)
2. Will plant on curves, on the contour and on steep slopes.
3. Safe—can't upset unless the tractor does.
4. Subsoiler point lossens and lifts soil. Allows better root spread and better packing.
5. Easily transportable—raise with power lift and drive away.
6. Heeling wheels on indivdiual springs for better heeling.
7. Pneumatic tires furnished at no extra cost.

*For further information and close-up photos write*

ROOTSPRED
318 N. Market St., Frederick, Md.

### Gypsy, Brown-Tail Moth Area Extended

Extension of the gypsy moth and brown-tail moth infested area in Connecticut includes 21 additional towns in Litchfield and New Haven counties.

The entire States of Connecticut, Maine, Mass., New Hampshire, New York, Rhode Island, and Vermont are included within the gypsy moth and brown-tail moth quarantined zone. However, only those portions of these states actually infested are subject to regulation.

In the regulated area (made up of the generally infested and suppressive areas), the U. S. Department of Agriculture and cooperating states set up inspection, utilization, or chemical treatment requirements that must be met before timber and timber products; plants having persistent woody stems and parts thereof, including Christmas trees; stone and quarry products; and any other products found infested; may be moved interstate from the regulated area to non-infested parts of the United States.

### Scalper Tree Planter

A rugged "scalper-tree planter," developed by the Michigan Conservation Department when commercial models proved too light for use under certain Michigan conditions, is nearing completion tests that have lasted two years.

Designed by T. E. Daw, assistant chief of the department's forestry division, the husky machine is operated by two men and can plant 8,000 to 10,000 trees in a day under normal conditions.

The first test model was constructed at Roscommon forest fire experiment station in 1949-50, and tested in the 1950 fall planting season. In the winter of 1950-51, six more machines were built, with improvements designed during the first test period. These were used during the 1951 planting season, where weaknesses were noted for correction.

Recently, a change in the planting shoe strengthened the machine to allow work in exceptionally heavy ground vegetation.

### Glacier National Park Important to Montana

In a report issued by the Montana State Highway Commission in cooperation with the Bureau of Public Roads and the National Park Service, Glacier National Park is credited with bringing into the state of Montana slightly more than $12 million during the 1951 tourist season.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**Just off the press! Jam-packed with facts about microwave . . . what it is, how it works, *what it can do for you!* For your *FREE* copy, mail coupon now!**

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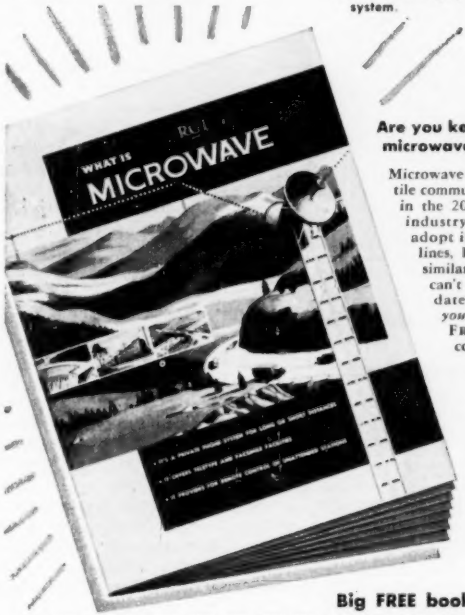
   - **a big power utility.**
   - **a long-distance pipe line.**
   - **a fish and game commission.**
   - **a 300-mile turnpike.**
   - **a 1000-mile Western Union system.**
3. **How microwave operates a pumping station by remote control.**
4. **What goes into a typical microwave system.**
5. **How RCA helps you install your microwave system.**

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Microwave is one of the most versatile communication tools developed in the 20th century. No wonder industry has been so quick to adopt it for power lines, pipe lines, highways, railroads, and similar applications. You just can't afford *not* to be up to date on microwave. So get *your own copy* of this big new FREE book... mail handy coupon... RIGHT NOW!

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Without obligation, please send me my own FREE copy of your big brand-new book: "WHAT IS MICROWAVE?"

Name_____ Position_____

Company_____

Address_____ City_____ State_____

Please give me additional information on microwave for the application following:_____

**RADIO CORPORATION of AMERICA**

### International Paper Adds Another Forester

Boyd L. Arnold has been appointed conservation forester in Alabama for International Paper Company with headquarters in Mobile. Arnold is a graduate of the University of Georgia School of Forestry. After graduation in 1950, he began work with International Paper Company on the timber cruising party in Florida. Prior to his appointment as conservation forester he was in timberland management work at Panama City, Fla.

### Correspondence Course In Farm Forestry

The Graduate School, U. S. Department of Agriculture, announces a new correspondence course, "Farm Forestry," designed especially for extension workers, teachers of agriculture, conservationists, foresters, and farmers.

The course is concerned with the growing of wood as a farm crop as contrasted with commercial forestry. John F. Preston, recently retired as chief forester of the Soil Conservation Service, and author of *Farm Wood Crops* and *Developing Farm Woodlands*, is the instructor.

The total fee for the course is $33.00, which includes tuition, books, and mailing costs. Students may register by writing to Graduate School, U. S. Department of Agriculture, Washington 25, D. C.

## Forestry Employment

S.A.F. members are privileged to insert one 60 word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiation.

## POSITIONS WANTED

Forester, 27, B.S.F. eastern university, desires position in Northeast. Five years' experience in timber cruising, log grading, ownership survey, management of private estate. Presently employed with U. S. Forest Service. Junior member, S. A. F. References and details on request. **Box V, Journal of Forestry, Mills Building, Washington 6, D. C.**

Forestry graduate with M.S.F. game management, age 43, now self-employed farming, desires return to professional work. 1 year C.C.C. technician U. S. Forest Service, 4½ years naturalist Hawaii NP, 6 years refuge manager U.S.F.W.S. Believe combination of government work and farming fits me for wildland management, range reseeding, public contact, or extension work involving farmer-forestry or game relations, or teaching. **Box W, Journal of Forestry, Mills Building, Washington 6, D. C.**

### John Druckenbrod Joins NLMA

The National Lumber Manufacturers Association has announced the appointment of John Druckenbrod, former Washington correspondent for International News Service, to the NLMA Public Relations Department as editor of publications.

Druckenbrod, 28, has worked in the Washington Bureau of INS since 1946, reporting on the activities of government executive agencies.

In addition, he has written a twice-monthly column on Washington lumber developments for the Southern Lumberman, trade journal published in Nashville, Tenn., since March 1951.

### NLMA Anniversary Proceedings

The proceedings of the National Lumber Manufacturers Association's Golden Anniversary meeting held May 8-10 at St. Louis, Mo. are now available.

The book is a chronicle of the past fifty years in the lumber industry and carries much good advice for the next fifty. Included are all the speeches on forestry, production, lumber products, new products from wood, and distribution which were presented in special sessions by authorities in each field.

Copies are available from the National Lumber Manufacturers Association, 1319 Eighteenth Street, N. W., Washington 6, D. C. at $2.50 each.

### NLMA Annual Meeting Scheduled

The 1952 annual meeting of the National Lumber Manufacturers Association will be held at the Shoreham Hotel, Washington, D. C., November 11-15. Approximately 100 lumbermen are expected to attend.

Presiding over the five-day session will be Corydon Wagner, vice president and treasurer of the St. Paul and Tacoma Lumber Company, Tacoma, Wash., chairman of the NLMA board of directors.

Meetings of standing and special committees are scheduled. Discussions by committee members will cover sales training, public relations, products and research, foreign trade, building codes, and trade promotion.

The annual business meeting of the association will be followed by a meeting of the stockholders and an organization meeting of the newly elected board of directors to elect officers and committee members for next year.

### $365 Is Average Starting Pay, Syracuse Paper Technologists

An average starting salary of $365 a month for positions in the paper industry was accepted by 14 seniors in pulp and paper technology graduated in June by State University of New York's College of Forestry at Syracuse. The salary range for the 14 entering industry at once was from $300 to $400 a month.

The class brought to 455 the number of men and women graduated by Professor C. Earl Libby in the 32 years since he helped organize the training in pulp and paper technology at the College of Forestry. Professor Libby, now with the School of Forestry, North Carolina State College, leaves a department staffed with 30 persons and laboratories and a full-size paper mill with a replacement value of $1 million—about ten times the original (1937) and subsequent investments in it.

### Southeast Forestry Awards Made

Rewards for outstanding forestry projects in the cooperative Future Farmers Association forestry program have been made to 26 southeastern farm boys. Presentations were made by Robert N. Hoskins, industrial forester for the Seaboard Air Line Railroad at the various annual conventions of the FFA in Virginia, North Carolina, South Carolina, Georgia, Florida, and Alabama. Top winner for each state received an all-expense trip to the national convention of the FFA in Kansas City, Mo.

### Adds 61,752 Acres to Ohio's Tree Farms

Twenty tracts of forest land adding up to 61,752 acres were designated officially as a Tree Farm, August 6, at the high school athletic field at McArthur, Ohio, before a crowd of nearly 400 persons. The giant tree farm is managed and partly owned by The Baker Wood Preserving Company, a subsidiary of D. B. Frampton and Company, Columbus.

D. B. Frampton, in accepting the certificate awarded by the Ohio Forestry Association sponsor of the state's 6-year-old tree growing program, said. "We can't survive jumping around, we must grow trees."

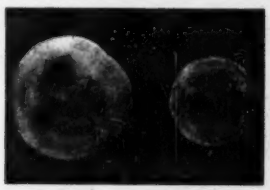
Four full-time foresters manage The Baker Wood Preserving Company Tree Farm.

The American Tree Farm System now includes 3,800 private landowners with forest holdings totaling 26,100,000 acres.

# HERE'S PROOF *that* OSMOSE TREATED LUMBER *Lasts Longer*

The board at the left is a piece of Osmose treated Lumber and was subjected to severe exposure tests. Upon examination it was found to be strong and healthy, unaffected by fungi or wood destroying insects.

This piece of ordinary, untreated lumber was subjected to identical exposure tests and the difference in appearance speaks for itself. This board had lost most of its natural strength, crumbled in the hand and was practically consumed by pests that habitually attack unprotected wood.



**The light areas in these cross sections from Osmose treated posts graphically portray the deep penetration of the toxic salts. Small dark areas deep in the center of the wood are only spots not fully protected.**

**Here's what happens when you build with untreated lumber that is subjected to moisture. This porch built directly on the ground would have lasted 3 to 5 times longer if it had been constructed of Osmose treated Lumber.**

★ ***WON'T ROT!***
★ ***REPELS TERMITES!***
★ ***LASTS 3 TO 5 TIMES LONGER!***

Men who know lumber also know that lumber doesn't just wear out . . . it is literally "eaten up" by fungi and hordes of wood destroying insects. However, Osmose treated Lumber stops these pests cold! Osmose treated Lumber is ordinary lumber that has been treated with Osmosalts (a highly toxic chemical mixture) that makes it resistant to decay and termites.

Naturally, the user pays a small premium for Osmose treated Lumber, but when you consider that it lasts 3 to 5 times longer, is fire retardant and NEED NOT BE PAINTED, the use of untreated lumber appears impractical indeed. Osmose treated Lumber, unpainted, is ideal for modern ranch-type houses, cottages, barns, outbuildings, bridges and all types of industrial construction. If you prefer, Osmose treated Lumber can easily be painted and the green treatment color acts as a base coat, thereby saving on paint.

Everything we say about Osmose treated Lumber has been proven over and over again during the past 15 years by our users as well as the Federal Government who have made exhaustive tests. Proof of these service tests is on file and you may have copies by writing to our headquarters. Osmose treated Lumber is sold through Authorized Producers whose operations are supervised and directed by graduate foresters trained specially by the OSMOSE WOOD PRESERVING CO. OF AMERICA, INC., 1437 BAILEY AVE., BUFFALO 12, N. Y.

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is like having
a double crew
on each job!"

**Uni-Channel Sensicon Dispatcher** puts 2-way radio contact in every vehicle . . takes jolts and shocks of rough terrain . . . cuts "dead" mileage . . . speeds operations.

**Handie-Talkie®** radiophone gives instant contact wherever a man can go . . . reaches mobile units and base stations . . . boosts efficiency of work crews.

**Base Station Remote Console** controls high-powered transmitter . . . centralizes dispatching . . . co-ordinates, logging, forestry and fire-fighting activities.

**LUMBERMEN ARE DISCOVERING THE MANY LABOR-SAVING AND SAFETY ADVANTAGES OF**

## MOTOROLA *INSTANT* COMMUNICATION

Motorola radio provides vital contact with every man in your crew. Two-way radio brings *instant control* of every situation. Mobile radio offers complete co-ordination of all your activities . . . cuts travel time . . . boosts *productive* man-hours . . . reports equipment breakdowns . . . summons help. Motorola radio is ruggedly built, quickly installed and easily operated—a *hard-working tool* for day-in, day-out utility.

*But*, in addition—*Motorola* is today's greatest value in 2-way radio. Eight exclusive Motorola features guarantee precision selectivity . . . time-tested durability . . . obsolescence-proof design. Motorola engineering puts 24 years of electronics leadership into every custom-tailored installation. Write today! Let a friendly Motorola engineer in your vicinity tell you how Motorola 2-way radio can boost *your* production!

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